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Pleistocene beaches of Natal

by

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SYNOPSIS

In the absence of fauna, rolled artefacts are the only usable zone-fossils for tracing and dating pleistocene shorelines in Natal. A shoreline at 60 m, with upwarp between Durban and River Mtamvuna, has been traced by its yield of the most primitive hand-axes; it can be followed from northern Zululand into the Ciskei. It is probably contemporary with the Cromer interglacial. Four higher shorelines, with increasing upwarp, have been tentatively traced at 155 m, 110 m, 82 m and 73 m; the artefacts that their gravels contain are pebble-tools, not diagnostic to distinguish chronological development. Below the 60-metre shoreline there are others at 48 m, possibly 38 m, 30 m, 18 m, 9 m, 6 m and two holocene levels about 3·5 and 1·5 m M.S.L. The 30-metre beach is very slightly upwarped, those lower are not. Down to the 9-metre beach they yield occasional hand-axes, not enough to distinguish one level from another. The 9-metre shoreline almost certainly belongs to the Eem interglacial. Associated with the 6-metre level are probably post-Acheulian artefacts. Isotopic dates and geological evidence from the southern and low latitudes of the Northern Hemisphere associate this shoreline with the Paudorf interstadial. The holocene levels have not in Natal yielded datable material, and may be dated only by comparison with other lands.

INTRODUCTION

At a time when two other accounts of raised beaches in Natal are in the press,[1] it has seemed desirable that I should add my contribution particularly on their archaeological content. In 1948–51 I made considerable collections from beach-gravels. Late in 1951 these were deposited for safe-keeping in the Archaeological Survey, Johannesburg; and many pieces have recently been recovered and restudied. Unfortunately it seems that, with the dissolution of the Archaeological Survey and the move of its collections several times around the University campus, some pieces have been mislaid. Although one or two more boxes of my material, which includes finds from all parts of Natal and not only from the coast, may still be identifiable, I seem to have recovered most of what is in the store of the Archaeology Sub-Department of the University of the Witwatersrand. As a result, for certain sites I have had to depend on identifications made 15 years ago, which I might not accept today; and I am not certain that I have recovered all the material from every site. I have therefore, in the table of beaches and finds, marked with an obelus those pieces which I have been unable to control. Furthermore, it might have been desirable to illustrate a few of the missing pieces.

This report is longer and more lucid than the short report which I wrote hurriedly before leaving Natal in 1951.[2] It was my desire one day to illustrate the material from the Natal beaches; and the grid-references which I gave in my former paper are now out of use, and cannot be identified on modern maps, so must be replaced by latitude and longitude.

In 1965 I was appointed chairman of the subcommittee on Eurafrican pleistocene shorelines of the International Quaternary Association. In 1967 I was able to check most of the occurrences of shorelines that I had recorded 15 years before and a number of fresh ones, which had been observed by Dr R. R. Maud and Mr R. C. Walsh. Some of the older occurrences are destroyed or grassed; and it is not now possible to replace many of the older archaeological collections. However, additional pieces have been collected, and some of these have been used for this paper.

The horizontal map of Natal shorelines (fig. 1) is inserted mainly to orientate the reader on localities. All the pleistocene occurrences south of River Tugela are within a few kilometres of the present coast; the coastal region rises steeply and is deeply incised, so that estuarine or near-estuarine gravels occur a short way inland. In Zululand and Tongaland, however, the wide coastal plain, resting on a gently dipping shelf of cretaceous rock, separates the oldest shorelines from the present coast by over 60 km; and across the plain dunes, forest and swamps mask most of the intermediate shorelines. A similar situation has arisen near Durban, where The Bluff, of fairly recent and largely aeolian formation, encloses a partly flooded plain, while the older shorelines are traceable along the continental scarp 8–10 km from the shore.

It is generally agreed that Natal has been greatly upwarped over a long period, so that the coastal zone is often fractured, and in Zululand is formed of tilted beds of Jurassic basalts which cap the south-eastern part of the continent in the Drakensberg. A series of surfaces has been mapped, indicating the stages of the upwarping. The lowest is at 120–200 m above S.L. on the eastern Pondoland coast,[3] and is thought to be plio-pleistocene. These surfaces are too old for beach deposits to have been normally preserved on them. The only beach which I would consider pliocene is at Doornkloof behind Tongaat (no. 928, 29° 30′S 31° 05′E), with rolled boulders, one with cones of percussion, and cliff-base at 269 m.[4]

After discussion with colleagues and study of the vertical maps I have drawn (folders 1–4), I have come to the conclusion that the coast of Zululand has been almost stable during the Pleistocene. South of Durban, however, all the older beaches are upwarped, progressively more so with age. This conclusion is based on the levels of the 60-metre beach, which contains the earliest hand-axes. These are fairly diagnostic; but the pebble-tools which occur in earlier beaches are not, and from them alone it would be impossible to work out the successive sea-levels. There is no other evidence from the older beaches; fauna never occurs in them. It must be admitted that the evidence from artefacts is incomplete, and the beach-lines that I have drawn are tentative.

The 60-metre beach has been identified in the northern and western Transkei; so the southward dip, evidenced on the north bank of River Mtamvuna* (no. 19 at just over 68 m), reduced it to its unwarped level (61+ m, south bank River Mtamvuna; 58 m, Mzamba mouth; 61+ m, Nsikaba mouth; 61 m, Coffee Bay; 58+ m, Bashee mouth; 61± m, Qora mouth; 61+ m, Cebe). But no artefacts have been found on it to prove its date. There are several occurrences in the Ciskei; at East London I found among its

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* The spelling of place-names with initial M— follows the practice of the recent Ordnance Maps. On older South African and on foreign maps they are spelt with initial Um—.

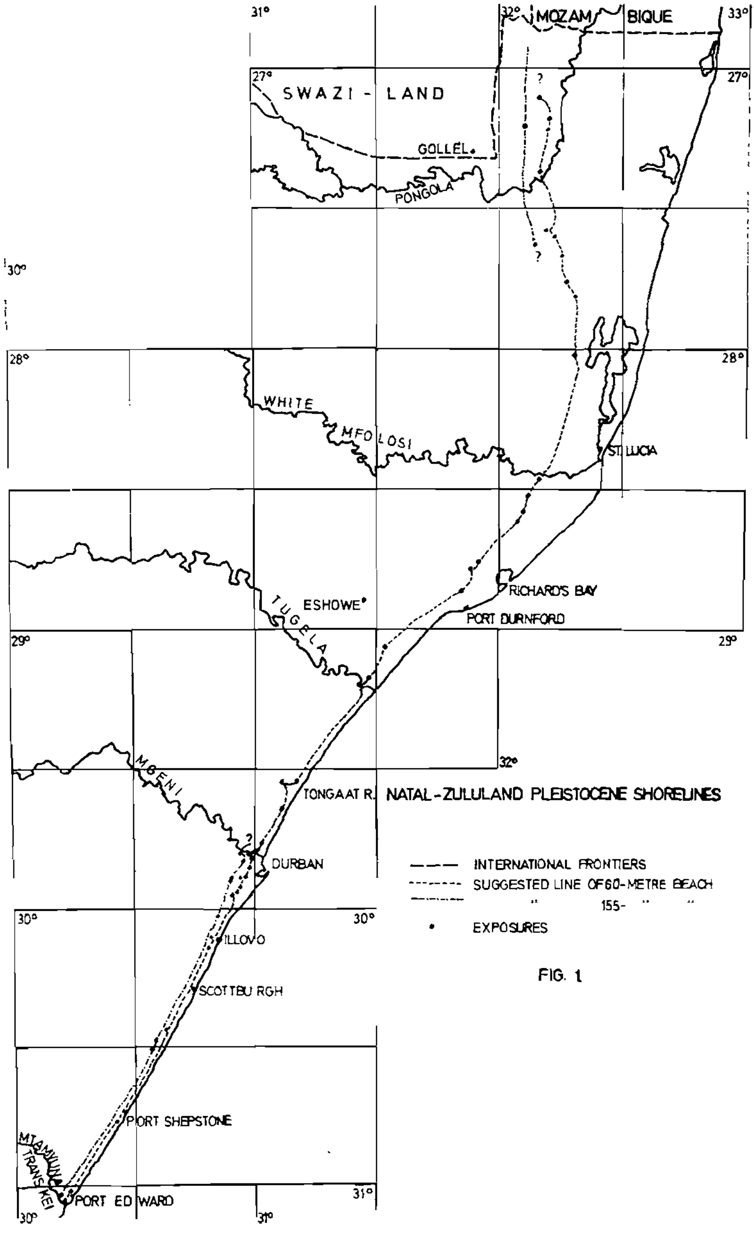
NATAL-ZULULAND PLEISTOCENE SHORELINES
INTERNATIONAL FRONTIERS
SUGGESTED LINE OF 60-METRE BEACH
" 155- " "
EXPOSURES
MOZAMBIQUE
SWAZI-LAND
GOLLEL
PONGOLA
WHITE MFOLOSI
ST LUCIA
TUGELA
ESHOWE
RICHARDS BAY
PORT DURNFORD
MGENI
TONGAAT R.
DURBAN
ILLOVO
SCOTTBURGH
PORT SHEPSTONE
MTAMVUNA
TRANSKEI
PORT EDWARD
27°
28°
29°
30°
31°
32°
33°
?

FIG. 1

gravel a rolled primitive hand-axe. Apart from the gap near Port St Johns, where it may or may not have been warped, it can be traced at a nearly constant level to East London and probably beyond Port Elizabeth. The higher beaches occur so rarely south of Natal and are so lacking in characteristics that it is impossible to plot them even tentatively.

I have made no attempt to trace the 60-metre or any other shoreline northward into Mozambique. I have been unable to correlate Barradas's data with my own observations in Natal. See *Boletim da Sociedade de Estudos de Moçambique* **90** (1955): 69.

The supposition that Zululand has been stable during the Pleistocene and that there has been no more than a slight upwarp in southern Natal implies that the line of red sandhills, which extends from north of the northern border of the province into the northern Transkei, is entirely aeolian save perhaps for vlei-deposits. In Tongoland these sandhills are far inland, and run parallel not to the present coastline but to the Lebombo Mountains. If we accept this conclusion, we must admit that in Sangoan times men carried an enormous tonnage of stone up the dunes, often from considerable distances, much of which they never used, and some (especially pegmatites) was unusable for artefacts. I have discussed this question in another paper.[5] I do not here wish to consider the age of the red sandhills. They overlie nearly all the pleistocene beaches at one place or another, and their formation has been composite. For instance, at Umwabi Road, Isipingo (nos. 977–8), there is an unconformity between a lower dune, banked against the cliff of the 33-metre beach, and an upper dune which covers the whole rock-profile. In the lower dune was found an unrolled hand-axe, Acheulian but not typical; near the surface of the upper is a line of pebbles, known on many sites to carry Sangoan pieces.

The tables here published are simpler than those roneoed for the Inqua commission, and omit map-coordinates, the name of the locality, the geological evidence and the reference. The last is usually field-work of myself and Mr R. C. Walsh, sometimes based on information from Dr R. R. Maud. Place-names and much of the evidence are incorporated in the text, and latitude can be worked out from the vertical maps.

The first column gives site-numbers of the occurrences which are included on the vertical maps. When the lists were drawn up, certain less important occurrences were not included and have not received numbers; these are indicated by latitude only, and can so be identified on the vertical map.

In the second column are altitudes in metres above M.S.L.[6] Where the top of a beach is certain or nearly so, and it has been possible to measure a cliff-base, a deltaic lagoonal gravel, an estuarine deposit or some other reliable feature, an absolute figure is given. If the occurrence cannot be proved to mark the top of the beach, though it may be a very short way from it, a + is added to the figure. A minus sign indicates that the beach was a little lower than, for instance, a recorded exposure of river-gravel which is not far from the estuary; but I have made little use of river-gravels or flood-plains, as I consider them unreliable indicators of corresponding sea-levels. A ± sign indicates that the figure is approximate. Practically all measurements above 6 m had to be taken with an aneroid, so are not extremely accurate. They may well be as much as two metres out, owing to diurnal variation of pressure, setting of the aneroid by the placarded altitude of a railway-station which is often inaccurate, or for other reasons. The low levels in Table 2 (Folders 3–4) are more accurate, and could usually be taken directly from M.S.L. or from high-tide mark.

It is more important that they should be accurate, as there is much less interval between the lower beaches than between the higher.

Columns 3, 4 and 5 summarise the artefacts found. In Column 3 are inventory-numbers of the Natal Provincial Museum; material which I recorded in 1949–51 but have not recovered from store in Johannesburg is marked with an obelus (†). Rolled artefacts in a marine or estuarine gravel are usually not much older than the abandonment of the gravel by the sea, as they would rapidly become unrecognisable. Some, however, may be derived from an older beach or land-surface. Unrolled artefacts are younger than the abandonment of the beach, often very much younger, and merely provide a limiting date. All rolled artefacts which appear diagnostic are illustrated.

THE VERY HIGH BEACHES

The occurrences of the very high beaches are scattered and confusing. Assuming that in the Early Pleistocene tectonic conditions were similar to those of the Middle Pleistocene (60-metre beach), I have tentatively sketched the lines of four sea-levels, at absolute (unwarped) altitudes of about 155, 110, 82 and 73 m. There may well have been other levels, and in certain areas wide platforms have been observed. These are believed to be marine, but their cliffs are not extant, so their absolute altitudes can at best be guessed. It has frequently been observed that even where a cliff can be narrowly located, it has been eroded by a valley, which has destroyed the junction between the platform and the rising ground above it. On the modern shore I have seen cliffs truncating very low beaches which are awash with spray. The spray runs off the upper surface and over the cliff, forming a shallow lateral channel at its foot. Such channels may be the start of lateral valleys, which deepen with regression and by scarp-retreat remove the cliff.

All the higher exposures seem to belong to the 155-metre beach, which has a marked upwarp between Durban and River Mtamvuna, where the cliff is visibly tilted southwards. In Tongaland a very wide platform, cut largely in basalt to this level, forms the foot of the Lebombo Mountains. The platform dips eastward, and may have been partly flooded by later transgressions, which have left no record on it in the form of pebble-concentrations and cliff-stumps. Much of it is covered by low dune. Evidence of marine transgression has been obtained at only two points. At many others along the foot of the mountains it is probably available, and some of the valleys incising the platform carry gravels which may be derived from it; for instance, there are broken T.M.S.* pebbles in the valley near Opondweni (27° 19′S 32° 06′E), which must either have been humanly transported or derived from a beach with longshore drift from one of the poorts through the mountains. The two sites with direct evidence are the Lubombu drift (no. 75, 27° 13′S 32° 06′E) and the gate of Mkuzi Game Reserve (no. 715, 27° 38′S 32° 09′E). At the former the platform is about 6 km wide, at the latter about 9.

South of River Mkuzi there is a long gap as far as River Mgeni, throughout which this platform has nowhere been observed. There appear to be surfaces at approximately 155 m near Mtubatuba, Gingindlovu and Tugela, but no direct proof of marine transgression.

Within the municipality of Durban are several exposures of the 155-metre beach or of detritus derived from it. Close to the reservoir near 45th Cutting (no. 951) are pebbles which give way to lateritic nodules, and ferricrete overlies damp sandy clay containing pebbles.[7] This seems to have been the edge of a littoral or lagoonal deposit. Mhlatuzana, a short way to the south (no. 957, 29° 54'S 30° 55'E), is the only site on this platform which has yielded rolled pebble-tools.[8] The platform is at 155 m with no extant cliff; the cliff-base cannot have been much higher. At about this point the upwarp seems to start. Whether site 011 at the back of Mlazi township (30° 02'S 30° 51'E), with beach-pebbles dying out at 177 m but no true beach-deposit or cliff, really belongs to this level is uncertain. Sites 044 (Nomokhanzana, 30° 29'S 30° 35'E) and 045 (Emoyeni south, 30° 30'S 30° 35'E) probably are part of the platform.

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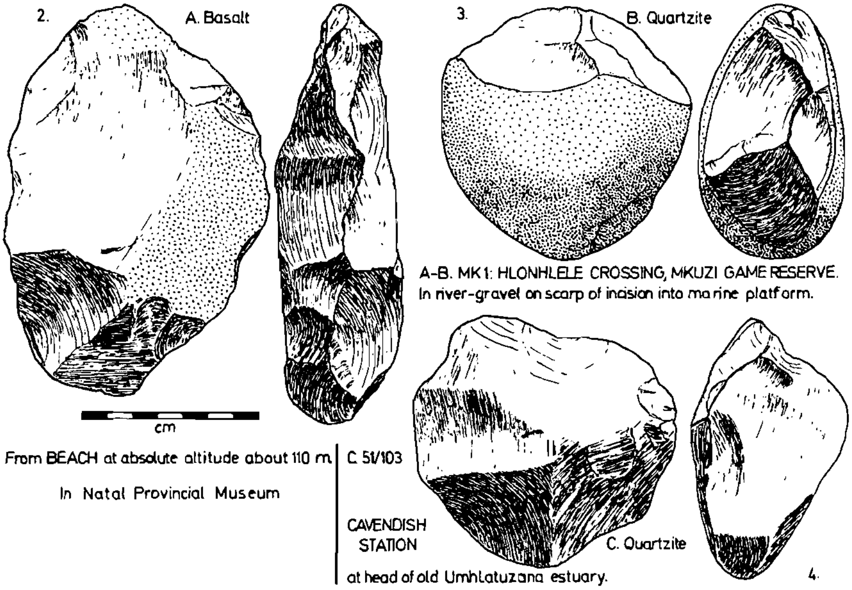
* Table Mountain Sandstone, a quartzitic rock of roughly Devonian age which occurs widely near the coasts of Natal and the Cape Province.

There is no good evidence for a sea-level between 155 and 110 m. Site 826 at Mtubatuba (28° 24'S 32° 10'E) carries a good scatter of beach-pebbles over a ridge which now rises to about 122 m, but may formerly have been higher. A scatter of pebbles, T.M.S. lava and agate, was traced near Bumbeni (27° 50'S 32° 17'E) up to over 122 m; but a piece of fossil wood among them suggested that this is detritus of a cretaceous rather than a pleistocene beach. Such cretaceous platforms, either recut (Mgeni Quarry no. 942, 29° 49'S 31° 01'E, with sharks' teeth), or carrying cretaceous deposits *in situ* (Clairwood, no. 962 at 47+ m, 29° 55'S 30° 58'E;[9] near Ubombo at about 105 m, 27° 30'S 32° 11'E), are recorded. But Professor King told me that he doubts if the T.M.S. was exposed in cretaceous times, so the presence of a good many quartzite pebbles may indicate a pleistocene age for Bumbeni; its level would be uncertain.

The 110-metre level appears to be traceable throughout Zululand and Natal, allowing for upwarping south of Durban. Primitive rolled artefacts have been found on several sites in its gravels (figs. 2–7; also *S. Afr. Archaeol. Bull.* 9 (1954): 62, fig. 1).


2.
A. Basalt
cm
From BEACH at absolute altitude about 110 m
In Natal Provincial Museum
3.
B. Quartzite
A-B. MK1: HLONHLELE CROSSING, MKUZI GAME RESERVE.
In river-gravel on scarp of incision into marine platform.
C 51/103
CAVENDISH STATION
C. Quartzite
at head of old Umhlatuzana estuary.
4.

Figs. 2–4.

To this level may belong the nickpoint at the head of the Pongola poort (no. 711, 27° 27'S 32° 00'E), if it is agreed that the poort has not been lowered by more than 10–12 m since. There are probable remains of it and of gravels derived from it on river-terraces in Mkuzi Game Reserve (nos. 714, 716 and two unnumbered sites), and two occurrences near Mtubatuba (no. 823, wide platform above River Instane, 28° 20'S 32° 12'E; platform at 28° 25'S 32° 10'E). At Ninians station just south of Empangeni there appears the detritus of a gravel over a hill whose summit is about 107 m (no. 844, 28° 48'S 31° 53'E), and several exposures of a beach *in situ* at 95 n (no. 845, pl. 1), with pebbles laid in ferruginised sand. The occurrence appears to have been at the head of a narrow bay, with ground rising to east and to north. This may have been an estuary of River Mhlatuzi. The altitude is discordant with any other occurrence in Natal; so perhaps the gravel, while derived from the 110-metre beach just to the east, was deposited under riverine or estuarine conditions during a regression and does not represent a maximum eustatic sea-level.

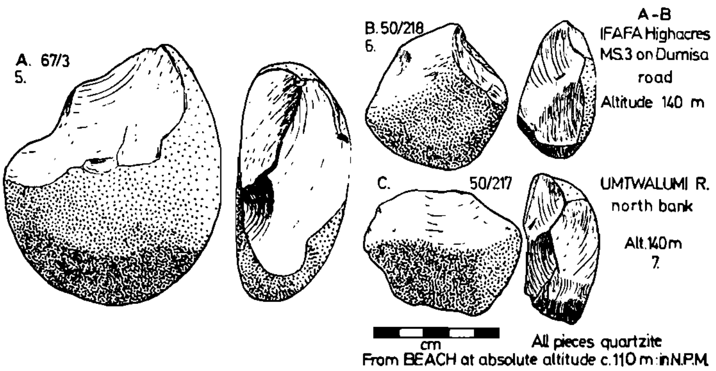
Maud claims a wide platform at about 110 m north of River Tugela. Though I noticed a few peaks at this altitude, I have been unable to identify the terrace, and it does not emerge plainly in the contours of the 1/50000 map. North of and up to River Tongaat are marine and estuarine gravels (nos. 926, 927, 929) at altitudes below 110 m; but as cliff-bases are nowhere preserved, it is possible that they are derived from about this level.

The upwarped area probably starts at Durban. So I have no hesitation in assigning to the 110-metre beach gravels at a rather higher level at Cavendish station (no. 958, 29° 54'S 30° 55'E, fig. 4) and Mhlatuzana 30th Avenue (no. 960). Sites at Ifafa Highacres

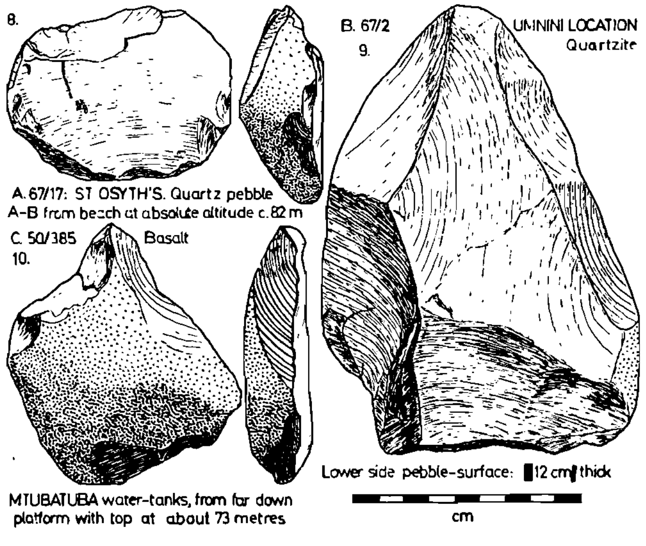
Ninians station, no. 845; beach-gravel at 95 m.

with cliff (no. 040, 30° 27′S 30° 37′E) and north of River Mtwalumi (no. 042), though as high as 140 m, may best be assigned to the upwarped 110-metre level (figs. 5–7). If there had been long-continued warping before the 60-metre level, the second terrace on River Mtamvuna (no. 16), despite its altitude of 155 m, could also belong to the 110-metre level.

The 82-metre level is not in evidence in Tongaland; but like lower levels may be concealed beneath the dune-cover of the plain. The most northerly recorded occurrence is at St Osyths (no. 846, 28° 49′S 31° 53′E, fig. 8), where a narrow shelf with pebbles abuts against a sharp rise, certainly a degraded cliff. After one probable occurrence at Good Hope on River Tugela (no. 92, 29° 12′S 31° 30′E), it may begin to be upwarped a short way north of Durban (highest occurrence of pebbles against a steep rise near La Mercy, no. 933, 29° 38′S 31° 07′E), and is more clearly marked from Lat. 30°S.



Figs. 5–7.


8.
A. 67/17: ST OSYTH'S. Quartz pebble
A-B from beach at absolute altitude c.82 m
C. 50/385
10.
Basalt
B. 67/2
9.
UMNINI LOCATION
Quartzite
Lower side pebble-surface: 12 cm thick
cm
MTUBATUBA water-tanks, from far down
platform with top at about 73 metres

Figs. 8–10.

Three sites appear to be at about the correct level of 92–98 m, increasingly higher to the south: Malakazi store with pebbles and beach-sand (no. 06, 30° 00′S 30° 54′E), estuarine above Illovo Mill (no. 017, 30° 05′S 30° 50′E), and in Umnini Location a wide flat on Ecca shale carrying a scatter of T.M.S. pebbles (no. 026, 30° 11′S 30° 47′E, fig. 9). There is another group near Hibberdene at about 110 m (no. 043, 30° 28′S 30° 37′E; 046, 30° 30′S 30° 36′E; 053, 30° 33′S 30° 32′E); the last is a dissected granite surface carrying rounded pebbles which are not immediately local. There is a well-marked platform again behind Port Shepstone (no. 064, Mtentwini west, 30° 42′S 30° 27′E; near the Norwegian Lutheran church, 30° 46′S 30° 25′E); and the same level appears on River Mtamvuna (no. 17).

The 73-metre level may have been revealed in a deep borrow-pit in a swamp east of Shongwe store (27° 26′S 32° 23′E); apparently Mosi Swamp, five km to the east, overlies a lower platform. This very fragmentary evidence illustrates the difficulty of detecting marine platforms in the undeveloped and dune-covered Tongaland plain. Behind Mtubatuba is a wide platform, dipping from 73 to 67 m, and carrying pebbles at several exposures (no. 827). One piece from far down on the platform is illustrated (fig. 10); several other pebble-tools, found at its head a short way north-west of the town, have not been recovered. This platform probably underlies the red dune which caps Mkwelane Hill on the south bank of River Mfolosi.

South of this point there is a long gap. The 73-metre platform reappears south of Durban, where it is upwarped to about 83 m. Site 014 is an exposure on the Kingsburgh–Pietermaritzburg road north-east of Illovo Mill. Two further exposures are recorded, south of River Mfazazaan at just over 92 m (no. 049, 30° 32′S 30° 36′E), and on River Mtamvuna (no. 18), beneath and immediately at the back of the Upper Red Desert.

It would be unwise to attempt to correlate any of the very high beaches with occurrences in other parts of the world or with the poorly known pre-Günz glaciations of Europe.[10] It may however be noticed that four pre-Günz or Calabrian sea-levels have been recorded[11] on the stable coast of Lebanon, as in Natal.

THE 60-METRE BEACH

This beach is traceable through Zululand and Natal and as far as the Ciskei. It provides a good marker-horizon, because the Early Acheulian hand-axes found in its gravels are much more diagnostic than the pebble-tools from higher levels. Before describing it, it is desirable to discuss the Port Durnford Beds in the Zululand bulge and the transgression with which they should be correlated.

The deposits at Port Durnford lighthouse (no. 851, 28° 55′S 31° 55′E) are exposed only at low tide. They are described by Anderson,[12] and Maud is publishing a revised section, perhaps observed at a slightly different place. Anderson gives the following section:

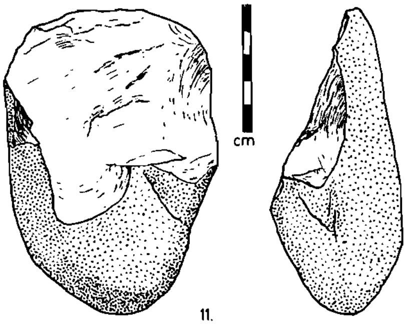
1. Wind-blown sand		
2. Carbonaceous layer		? old soil
3. Red sand without pebbles, down to 5–6 m M.S.L.		
4. Fossil wood and lignite		better called peat
5. Shales with fish	4 m thick	probably lagoonal; 5 is no longer visible, so may have been seaward of the present cliff
6. Ferruginous layer		

7. Ostrea and foraminifera	marine
8. Shale with fossil wood, mammal bones and comminuted shell	now completely eroded; probably lens of an old vlei
9. Red sandstone	? cretaceous; no longer visible.

The mammals found in layer 8 were Middle Pleistocene, including *Elephas zulu.*

The marine bed 7 must have transgressed over the vlei 8, and from the fauna in 8 presumably represents a low stage of a transgression which rose to a much higher level. An unconformity has been suggested between 7 and 6, as the lagoon of 5+6 must have formed when the sea had regressed. 5 may possibly have marked another marine transgression. 4 must be a marsh-deposit, and does not seem marine-planed, as its surface varies in altitude above M.S.L. along the bay, from 4·5 to 6 m.

In pot-holes in the marine-bed 7 exposed at low tide at the lighthouse are many ill-rolled small and large pebbles. Some are far-travelled, of T.M.S. or pre-Cambrian rock. Their shapes do not suggest marine origin, and they do not belong to the marine bed. They probably come from the edge of the vlei 8, which is being demolished out to sea. Among them was found a rough cleaver (fig. 11), Acheulian but not closely datable, not unsuitably associated with the mammalian fauna.



11.
QUARTZITE CLEAVER: N.P.M.67/18, PORT DURNFORD
Found among many pebbles loose on marine beds below M.S.L.
probably derived from mammal-bearing lagoon - beds

Fig. 11

The assumption that the marine bed 8 belongs to a Middle Pleistocene transgression to 30 or more metres implies that an enormous amount of material has been removed by erosion since this time. Inland of Port Durnford there is a flat several kilometres wide at about 15 m M.S.L. There is no evidence at present whether the pleistocene beds occupy only a pocket on the coast or extend for many kilometres to the north. The cretaceous bedrock is usually fossiliferous and easy to distinguish. There are traces of a fossiliferous miocene transgression only at Uloa Bridge (28° 28'S 32° 18'E).[13] At a number of points along the coast there are small non-fossiliferous exposures of soft sandy clays, which may be pleistocene:

Mfolosi Store, no. 832, apparently a terrace cut in calcified clay at about 49 m S.L.;
Uloa Bridge, overlying the miocene, about 6 m thick and up to 25 m S.L.;
west of St. Lucia estuary, exposed up to 13 m S.L.;
Malakatana Bay, no. 820, 28° 14′S 32° 25′E, planed at 6 m S.L. and perhaps rising higher;
Nyalazi dip, no. 815, 28° 09′S 32° 20′E, estuarine gravel on a shelf of sandy clay;
Hluhluwe railway-bridge, no. 813, 28° 08′S 32° 17′E; the gravel of the 28-metre river-terrace rests on yellowish clay more than 4 m thick;
below Ncemane station, no. 89, 28° 05′S 32° 20′E, a wide flat of sand with calcrete nodules at about 38 m S.L.;
Nibela, 27° 49′S 32° 24′E, a wide shelf of clayey sand at about 36 m S.L.

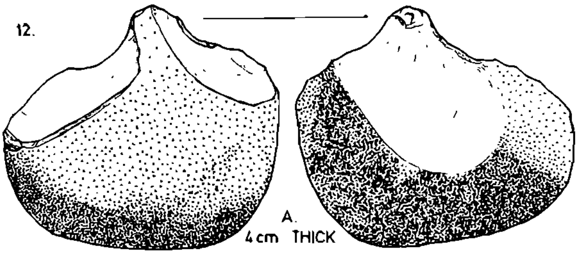
If all these occurrences belong to the same (pleistocene) transgression and are Port Durnford Beds, these must have been laid down by a transgression not lower than 49 m. But this level, discussed below, is not well marked; so one feels tempted to refer the Port Durnford Beds to the better attested 60-metre level, even if this involves a vast additional tonnage of material removed by erosion. There are beds of mottled sandy clay at 61 m at Kwambonambi and Penicuik (nos. 835–6, 28° 35′S 32° 06′E). This material does not appear aeolian, but its nature is uncertain. The fauna in Bed 8 at Port Durnford is not closely datable. Wells[14] is inclined to assign it to the Late Middle Pleistocene, in which case the transgression above it would more suitably be that of 30 m.

The platform at 61 m or slightly higher may be traced as far north as a wide shelf at the mouth of the Ingwavuma poort (no. 71, 27° 06′S 32° 10′E). A fragment of a sandy beach containing large pebbles was observed at 56 m east of Mlambongwenye store (no. 72, 27° 11′S 32° 12′E). A pebble-chopper was found just below it. This beach is distinct from the river-gravel about 6 m lower; but it is truncated westward by a small valley and then probably covered by dune, so the cliff-base cannot be identified or measured. Nondescript pebble-tools were found also among travelled pebbles emerging beneath dune at 61 m on the track to Mzinyeni dip (no. 76, 27° 13′S 32° 12′E). Above the Mfongosi pan (no. 710 27° 22′S 30° 10′E) is a wide terrace, gently dipping eastward. A slightly rolled hand-axe on it has not been recovered from Johannesburg; but a lower limit of date is provided by two unrolled hand-axes and a cleaver found in a river-gravel just below the platform, where marine pebbles on it give out.

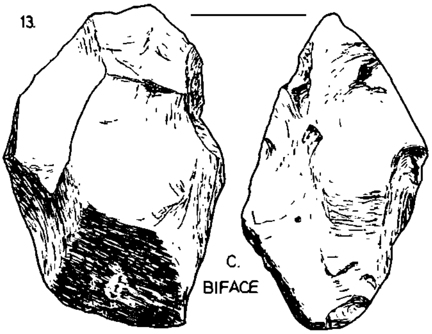
No exposures are known between Rivers Pongola and Mkuzi. In Mkuzi Game Reserve there is a wide terrace dipping from about 64 to 50 m, and extending at least 15 km as far east as Morrisvale, east of the Reserve (27° 41′S 32° 22′E), with a covering of small flattened beach-pebbles. Two exposures of beach-pebbles occur near the Munywana stream (no. 720, 27° 49′S 32° 18′E). No cliff survives, but the upward limit of the pebbles is close. Rolled and unrolled artefacts, including very primitive hand-axes, have been recovered from the beach-gravels and from the stream into which they have been derived (figs. 12–14).

Two occurrences near Hluhluwe (no. 86) bridge the gap to River Mfolosi. South of this there is a wide dissected platform at Mfolosi Motel and along the old main road to the south (no. 831, 28° 28′S 32° 07′E, fig. 15), which has yielded a rolled hand-axe and a split pebble. This level was picked up again near Eteza station (no. 834, 28° 31′S 32° 07′E),

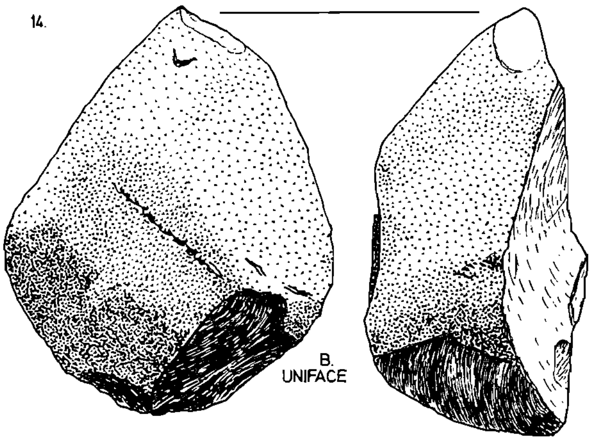
12.



13.



14.

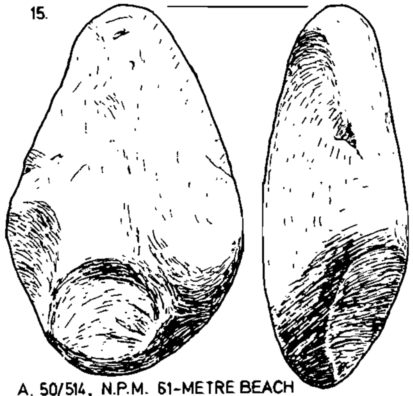


RIVER MUNIWANA, ZULULAND
C. 67/15, from gravel of 61-metre BEACH
A & B. 67/14, derived into river-bed
NATAL MUSEUM
cm

A. ? cretaceous mudstone
B & C. scoriaceous basalt

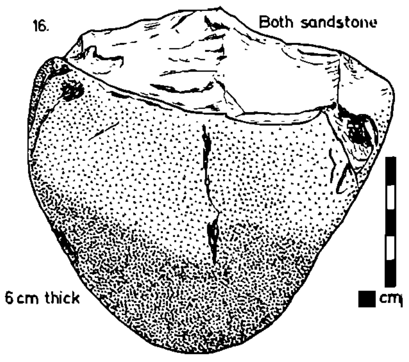
Figs. 12–14.

15.



A. 50/514, N.P.M. 61-METRE BEACH
s.w. of UMFOLOSI MOTEL on old main road

16.



B. N.P.M. 67/20. UNIV. COLLEGE of ZULULAND
below Zonzele store: 61-metre beach. Uniface

Figs. 15–16.

and perhaps in the mottled sands near Kwambonambi (nos. 835–6), discussed above Empangeni station (no. 842) rests on a platform at 64 m, with a sharp rise in rock along the railway close to the main road. The 61-metre level was seen again on a terrace of River Mhlatuzi on the main road, and at a small exposure on the drive to the University College of Zululand (no. 853, 28° 52′S 31° 51′E, fig. 16), where the cliff has been removed by a lateral stream.

There is a scatter of pebbles up to 61 m S.L. on the old main road south of Amatikulu (29° 03′S 31° 32′E), and a platform with pebbles just north of River Tugela (no. 93). Rolled cores, wide-angled flakes and a crude pick which I recorded from this site have not been recovered from Johannesburg. Terrace-gravels at the same altitude, probably estuarine, have been found on Rivers Tongaat and Mhloti (nos. 930, 934), the latter probably slightly upwarped.

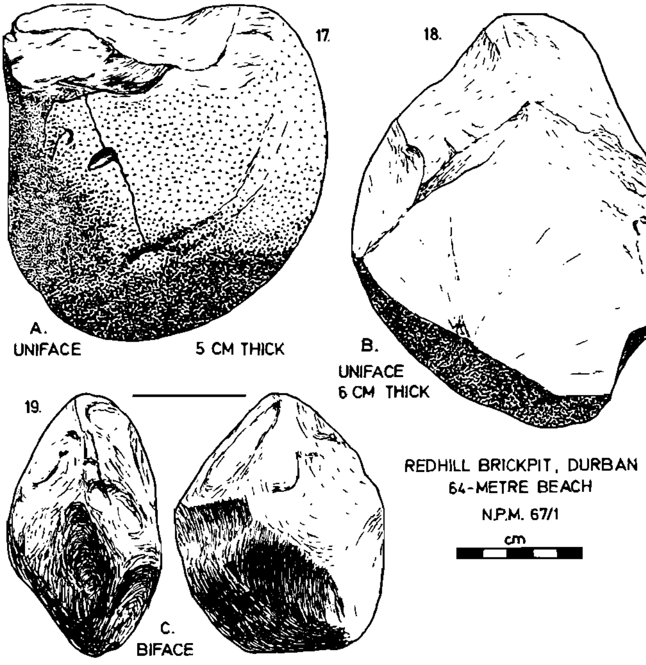
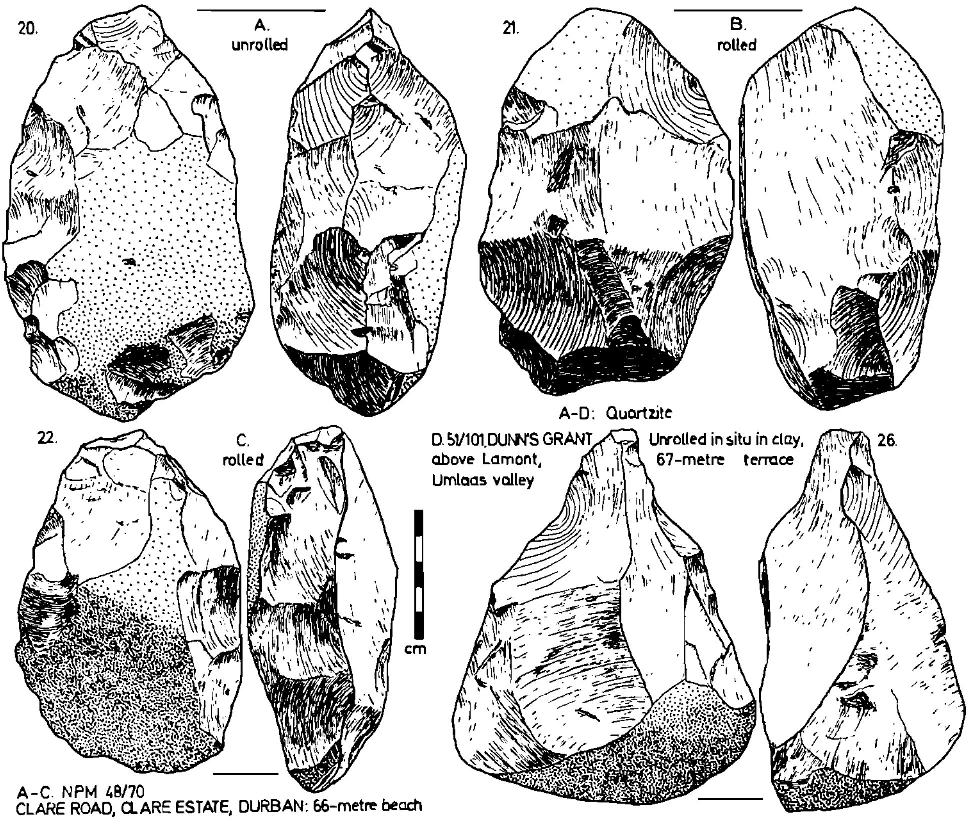


Fig. 17–19.

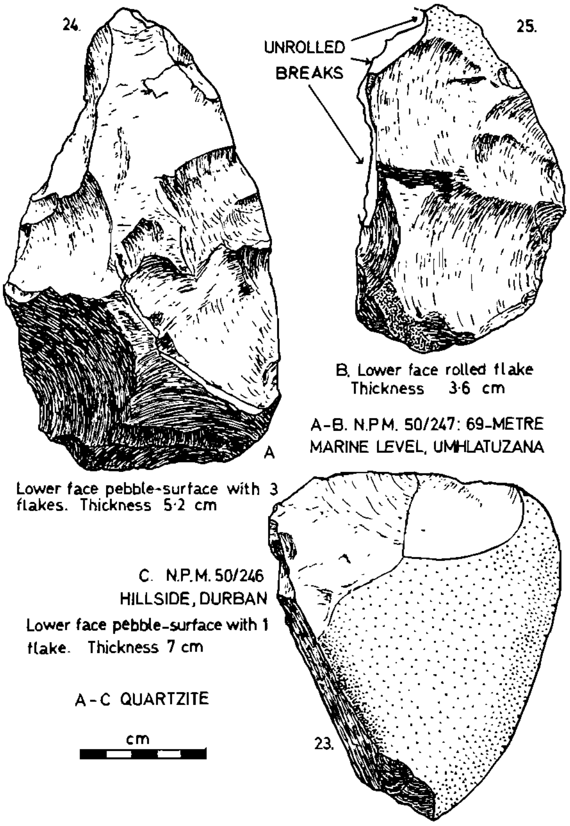
The Durban North brickpits have revealed a fine series of exposures of a platform at about 68 m (nos. 941–2). At Redhill is a layer about 1½ m thick of beach-pebbles containing Early Acheulian artefacts (figs. 17–19), beneath aeolian sand calcified near the base perhaps from the molluscs which the beach formerly contained.[15] On the surface of the aeolian sand are Sangoan pieces. Rolled Early Acheulian pieces were found also at Briardene (no. 942), but have not been recovered from Johannesburg. There are no artefacts from Mgeni Quarry, which is a recut cretaceous platform. The same level has been found slightly


20.
A.
unrolled
21.
B.
rolled
A-D: Quartzite
22.
C.
rolled
cm
D. 51/101, DUNN'S GRANT above Lamont, Umlaas valley
Unrolled in situ in clay, 67-metre terrace
26.
A-C. NPM 48/70
CLARE ROAD, CLARE ESTATE, DURBAN: 66-metre beach

Figs. 20–2, 26.

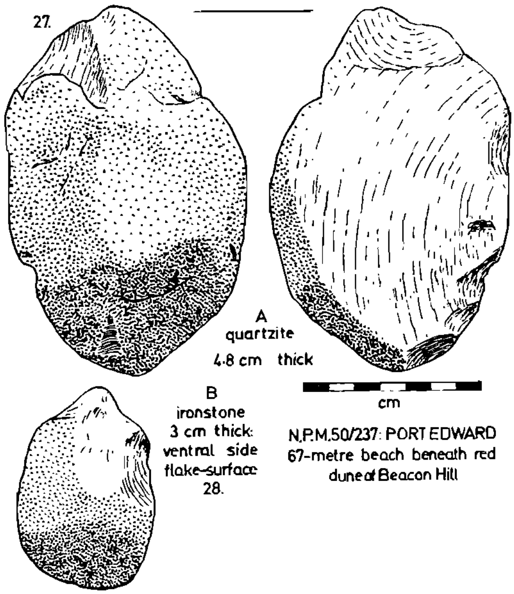
up River Mgeni at Clare Estate (no. 948) with rolled Early Acheulian picks and large flakes (figs. 20–22); and across Durban behind the Toll Gate, at Hillside (no. 959, fig. 23), Mhlatuzana (no. 961, figs. 24–25) and on River Mlaas near Lamont (no. 966, fig. 26). At the last exposure rough Early Acheulian pieces were found rolled and unrolled, some in a probably estuarine clay.

Recorded exposures of the 61-metre beach south of Durban are more scattered. There is a concentration of pebbles at 70 m at the Illovo Mill office (no. 018, 30° 06′S 30° 50′E), and a wide platform carrying flattened marine pebbles in Ifumi Reserve (no. 022, 30° 09′S 30° 49′E). On River Ifafa pebbles occur at 78 m (no. 039). A great many artefacts have been collected at this point,[16] but hardly anything rolled. There are unrolled Early Acheulian pieces, as well as later material, Acheulian III and Sangoan. Near River Mtamvuna there is a wide platform at 67 m at Leisure Bay (no. 102). At the base of Beacon Hill, Port Edward, beach-pebbles appear beneath the red dune (no. 19) with a few artefacts (figs. 27–28). It has been mentioned that the 61-metre beach can be traced in parts of the Transkei and at least as far as East London.


24.
25.
UNROLLED
BREAKS
A
B. Lower face rolled flake
Thickness 3·6 cm
A-B. N.P.M. 50/247: 69-METRE
MARINE LEVEL, UMHLATUZANA
Lower face pebble-surface with 3
flakes. Thickness 5·2 cm
C. N.P.M. 50/246
HILLSIDE, DURBAN
Lower face pebble-surface with 1
flake. Thickness 7 cm
A-C QUARTZITE
cm
23.

Figs. 23–5.

Mainly on the ground of the industry it carries, it is permissible to suggest that the 61-metre beach in Natal belongs to the Cromer interglacial of Europe. On River Somme the earliest hand-axes appear in the gravel of the 45-metre terrace, correlated with this interglacial, and in solifluxion-deposits of the previous glacial stage;[17] the corresponding level on the Thames appears to be the Ambersham Terrace at about 60 m.[18] Beaches at about 60 m near Cap d'Espichel (Portugal) are presumably of the same stage, but in general have yielded only atypical pebble-tools without hand-axes;[19] and the level has been noticed on the mountainous and indented coast of northern Spain.[20] In the Alpine zone of the Mediterranean there has been tectonic disturbance, so that this sea-level is at 83 m in Alpes Maritimes; a rostro-carinate, presumably of the earliest Abbevillian type, has been found with pebble-tools in a deposit of the preceding regressive stage.[21] On the stable coast of Lebanon a few hand-axes and other artefacts occur on a beach at 70–80 m, which appears to be distinct from the 60–65 metre beach of the Cromer stage and may have been formed during an interstadial of the Günz glaciation. In Morocco the beach of the Maarif stage with cliff-base at about 60 m carries the most primitive hand-axes slightly rolled.[22] In Ghana a marine platform at a corresponding level has not been recognised with assurance, and the



Figs. 27–8.

absence of primitive hand-axes would make it difficult to identify. There is a very wide peneplain ending in places in a beach at about 60 m; but it appears that the land has tilted seaward, and lower beaches, such as that at 30 m, are too low. So this peneplain probably belongs to an older sea-level.[23] The same peneplain has been noticed in the Ivory Coast.[24] South of River Congo all levels seem disturbed by tectonic movement, and a level corresponding to the 60-metre platform of Natal cannot be identified. It may be one of the levels revealed in the diamond-workings of South West Africa and Namaqualand; but which it is impossible to say.

Hand-axes of the earliest stage seem not to occur in India.[25] The oldest found in stratigraphical context are pieces called Abbeville-Acheulian from the 30-metre terrace.[26]

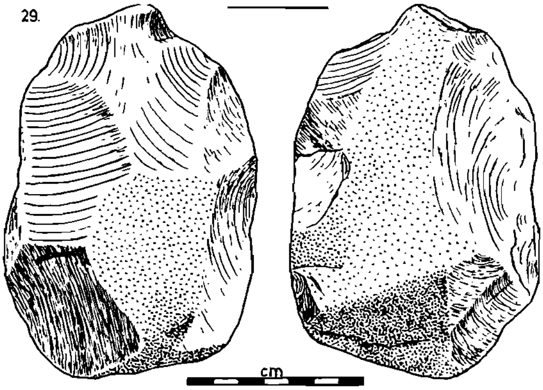
THE 48-METRE BEACH

A sea-level at 46–48 metres may be traced southward from River Mlalazi and perhaps from the ridge near Mfolosi store (no. 832, see above) through Natal to River Mtamvuna. It has not been recorded in the Transkei; but it reappears in the Ciskei (Morgan's Bay; probably Double Mouth Camp; Mtendwe; probably Bonza Bay;[27] Sunday's River;[28] probably Amsterdam Plein near Port Elizabeth; Fort Frederick at Port Elizabeth; Grasmere near Humansdorp). In Natal there is little sign of a marine platform, and the evidence for this level comes from what appears to have been estuaries. It does not seem to have been observed in other parts of the world. As the 30-metre level almost certainly corresponds to the Mindel-Riss (Holstein) interglacial, the 48-metre level may be a halt in the regression from the 61-metre beach, a high sea-level of a Mindel interstadial,[29] or less probably a short transgression at the beginning of the Holstein interglacial, after which the ocean retreated to 30 m. If the last, traces of it should have been observed on Mindel glacial deposits in Europe.

The most northerly reliable exposure in Zululand is a deposit of flattened laid pebbles on the main road just north of River Mlalazi (no. 854, 28° 55′S 31° 47′E). They can be traced up to 49 m. Dunes make it impossible to tell if the site is littoral or estuarine. There is no evidence for a higher beach whence the pebbles might be derived. On River Amatikulu at Shortburn (29° 04′S 31° 33′E) are rolled pebbles on a platform which may be a river-terrace grading to about 48 m; but the wide dunes between it and the sea make certainty impossible. Above the railway-bridge on Tugela River are pebbles and artefacts, perhaps Middle Acheulian (no. 94); this gravel is at about 44 m S.L., so it may belong to the 48-metre level or have graded to a lower level downstream. At Tugela Mouth pebbles occur up to 40 m, but the platform and cliff are concealed by dune. A gravel at 46 m above the river is to be seen on River Mvoti near Melville (no. 99), at 49 m on River Tongaat at Fairbreeze Hotel (no. 931–2), and on the main road as it descends from the south to River Mhloti (no. 937).

As upwarping seems to start just north of Durban, the 48-metre level cannot be identified in southern Natal merely on the basis of altitude. I would assign to it on Mgeni Riverside a terrace at 52–49 m (no. 943), almost certainly separate from the Brickfields platform at 68 m (see above, nos. 941–2) and from a 30-metre terrace which appears a little farther downstream. There are corresponding terraces with pebbles on River Mlaas at Lamont and on a stream at Isipingo (no. 977). Information about a rock-bench carrying beach-sand and Acheulian II artefacts at Mbogintwini superphosphate-plant (no. 010)[30] is too vague to evaluate, as the exact altitude was not recorded; it is said to have been about 58 m, too low for the 61-metre platform at this point. Estuarine pebbles with chatter-marks occur on River Illovo at Uba Drive up to about 50 m (no. 019) and on the Mpambinyoni at 60 m (no. 030). The gravel at Mfazazaan Bridge (no. 050) with Early Acheulian material (fig. 29) is probably estuarine. There are pebbles at about 58 m above Hibberdene (no. 054); but as the platform is concealed, it is uncertain if this is an estuarine level of

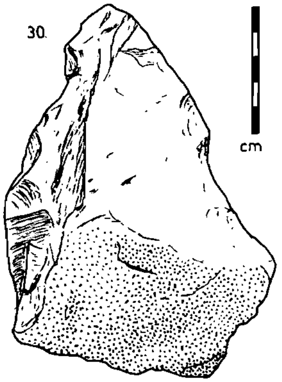
29.



50/212: UMFAZAZAAN RIVER SOUTH
From estuarine deposit with cliff-base at 60 m S.L.: 7.5 cm thick; quartzite

Fig. 29.

30.



N.P.M. 50/201: P.EDWARD, Isandlundlubridge
River-gravel, derived from lagoon-head gravel
at 43 m S.L.
Quartzite, 6·5 cm thick: joint-face below

Fig. 30

River Mzimai. A bench at Mzumbi (no. 058) carries sand grit and pebbles, perhaps marine rather than estuarine; no cliff is visible. Numerous pebbles excavated at Port Shepstone post-office at 55 m (no. 067) had probably accumulated in the Mzimkulu estuary. A small exposure of laid pebbles and sand without cliff at Marina Beach (no. 074) may be marine, as may exposures on River Impenjati near the turn to Trafalgar (no. 075).[31] There appears to be a terrace rising above 46 m at Leisure Bay (no. 103). The platform carrying pebbles and a crude pick, perhaps Early Acheulian (fig. 30) above the Isandlundlu bridge behind Port Edward (no. 11) is almost certainly estuarine; and there is a beach with cliff also on River Mtamvuna (no. 100) at about 50 m; this too could have been just at the river-mouth.

In Natal there is no conclusive evidence for marine, rather than estuarine, occurrences of the 48-metre level, though the deposits of sand with pebbles may be beaches. This feature makes it likely that this level was a halt in a regression. Unfortunately, few artefacts have been found in association; and they cannot be defined closely as Early or Middle Acheulian. A 45-metre beach as well as the 60-70 metre one has been observed at Ras Beyrouth and elsewhere in Lebanon; but it nowhere occurs on the same profile as the 30-metre beach.[32]

POSSIBLE BEACH-LEVEL ABOUT 38 METRES

A few widely separated exposures suggest the possibility of a sea-level about 38 m. On both banks of River Mfolosi is a probably estuarine terrace at about 37 m (no. 833, 28° 29′S 32° 10′E); it could not be measured with great accuracy, and may be a metre or two higher. More definite is a pocket of marine grit and pebbles against a cliff-stump at the level-crossing above River Enseleni (no. 837, 28° 41′S 32° 00′E), which extends south-west on to the next ridge. The next exposure is at 38 m at Blythedale Beach (no. 98, 29° 22′S 31° 21′E),[33] where marine sand and large pebbles overlie clay which may be weathered tillite; the cliff has been eroded by a stream, but just behind it rock rises sharply. Among the pebbles were found flakes which may be slightly rolled but are adiagnostic. The apparent

TABLE 1, FOLDERS 1–2.

Site no.	*Altitude*	*Artefact no.*	*Industry R*	*Industry U*	*Ill. fig.*
27° 06′	98+	† 50/266	—	Ach. ?II	
71	60+	—	—	—	
27° 11′	91+	50/258	—	M.S.A.	
72	56+	50/267, 67/7	† choppers derived	Sangoan, ? older	
75	159	—	—	Sangoan	
76	60+	67/10	choppers	Sangoan	
710	64	49/5, 67/19	† Ach. ?I	Ach. III	
27° 19′	115−	† 50/262	—	M.S.A.	
27° 26′	73±	—	—	—	
711	100±	50/306	—	Ach. ?II	
27° 35′	61+	—	—	—	
27° 35′	58+	—	—	—	
27° 36′	88+	—	—	—	
27° 36′	76+	MK2	—	M.S.A.	
713	64	—	—	M.S.A.	
714	110	MK1	Early Ach. derived	—	2 3
715	156	—	? flake in stream-gravel	—	
27° 38′	73+	—	—	—	
717	64	—	—	—	
27° 39′	55+	50/272	—	M.S.A.	
27° 39′	55+	MK3	—	—	
716	110	—	—	M.S.A.	
27° 40′	88+	—	—	—	
27° 41′	52+	—	—	—	
718	60+	—	—	—	
720	61	67/15	Ach. ?I	Late Ach.	12–14
27° 50′	120+	? cretaceous	—	M.S.A.	
724	74+	—	—	M.S.A.	
27° 58′	90+	—	—	—	
27° 59′	75±	50/309	—	M.S.A.	
28° 01′	104+	—	—	M.S.A.	
86	64	50/359a	pebble-tools	? Sangoan	
28° 05′	63±	—	—	—	
28° 08′	75±	50/355	—	Sangoan	
823	113+	50/365–6	† pebble-chopper	Sangoan	
28° 25′	113+	—	—	? M.S.A.	
826	122+	† 50/388	—	Early Ach.	
827	73	50/385	pebble-tools	Sangoan	10
28° 28′	73+	—	—	—	
831	61	50/513–4	Ach. I	Faur.-Sang.	15
832	49+	—	—	—	
834	61	50/382	—	Sangoan	
835	64+	—	—	—	
836	61+	† 49/14	—	? M.S.A.	
842	64	—	—	—	
843	95	—	—	—	
844	107+	—	—	—	
845	95	—	? pebble-tools	M.S.A.	pl. 1
846	82	67/17	pebble-tools	Sangoan	8
28° 49′	61±	50/377	†pebble-tools	—	
28° 50′	76+	50/380	†pebble-tools	pebble-chopper	
853	61	67/20–1	pebble-chopper	Sangoan	16
854	49	50/357	†pebble-tools	Sangoan	
29° 03′	61+	—	—	—	
29° 04′	49±	—	—	—	
94	44	48/51	†Early Ach.	Sangoan	
93	61±	48/52	† ? Ach. I	? Ach. II	
92	79+	48/54	?	Sangoan	
29° 12′	40+	48/53	—	Sangoan	

Site no.	*Altitude*	*Artefact no.*	*Industry R*	*Industry U*	*Ill. fig.*
99	46±	50/475	—	Sangoan	
928	269	—	—	—	
929	107+	—	? artefacts	M.S.A.	
29° 31′	58+	—	—	—	
927	95+	—	—	—	
930	64	—	—	—	
931	49	50/532	wide-angled flake	—	
926	101+	48/68	†pebble-tools	Sangoan	
932	49	—	—	—	
933	92	—	—	—	
934	69	—	—	Sangoan	
937	49+	—	—	—	
941	64+	67/1	Ach. I	Sangoan	17–19
29° 48′	153±	—	—	—	
942	68	48/67	†Early Ach.	Sangoan	
948	68	48/70	Early Ach.	Ach. II	20–22
943	51	—	—	—	
29° 49′	137+	—	—	—	
29° 49′	68	—	—	—	
951	155	—	—	—	
29° 50′	137+	—	—	—	
29° 51′	61+	—	—	—	
960	120±	50/248	pebble-tools	Sangoan	Umhlatuzana paper
959	70+	50/246	Ach. I	flakes	23
957	155+	50/249	pebble-tools	Sangoan	Umhlatuzana paper
958	120±	51/103	pebble-tools	Sangoan	4
961	69	50/247	Early Ach.	? Early Ach.	24–25
29° 54′	110+	51/106–7	pebble-tools	—	
29° 55′	155+	51/104	—	Sangoan	
962	47+	probably cretaceous	—	—	
966	70+	51/101	Ach. I	Ach. I	26
29° 56′	49+	50/232 51/102	pick	Sangoan	
29° 57′	62+	—	—	—	
969	62+	50/231	? Ach. I	? Ach. II	
29° 58′	61+	50/230	—	? M.S.A.	
977	46+	—	—	—	
29° 59′	107±	50/229	—	Sangoan	
06	92	50/244	—	Sangoan	
010	58±	J'hburg	? Ach. II	Sangoan	
012	86+	—	—	—	
011	177+	—	—	? Sangoan	
017	93+	50/227	—	Sangoan	
014	80+	—	—	—	
018	70	—	—	—	
019	50	—	—	—	
021	83	—	—	—	
022	68 ?+	—	—	—	
30° 10′	88+	50/228	—	Sangoan	
026	97+	67/2	pebble-tools	Sangoan	9
030	60	—	—	—	
031	44·5	—	—	—	
036	118+	50/224	pebble-tools	—	
037	165±	—	—	Sangoan	
038	118+	50/219	? 1 piece	Late Ach.	
039	78	50/204	? Ach. I	? Ach. III	
040	140	50/218 67/3	pebble-tools	Sangoan	5 6
042	140+	50/217	pebble-tools	Sangoan	7
043	110	50/215	—	pebble-tools	
044	185	—	—	—	
045	185	—	—	—	
30° 30′	168+	—	—	—	
046	110	50/216	—	? Ach. II	

Site no.	*Altitude*	*Artefact no.*	*Industry R*	*Industry U*	*Ill. fig.*
049	92+	—	—	Sangoan	
30° 30′	110±	50/245	—	flake	
050	60	50/212	Early Ach.	Middle Ach.	29
051	50+	58/53	—	Sangoan	
053	112+	—	—	—	
054	58+	50/240	—	Ach. ?II	
055	48	—	—	—	
058	55+	50/241	—	Sangoan	
064	115+	—	—	Sangoan	
067	55+	—	—	—	
30° 46′	113+	—	—	—	
30° 46′	69+	—	—	—	
074	50+	—	—	—	
075	50+	50/238	? artefacts	—	
102	67+	—	—	—	
103	46+	—	—	—	
11	43	50/201	Ach. ?I	Middle Ach.	30
15	190+	50/202	—	Ach. II	
16	155	—	—	—	
17	110±	—	—	—	
18	85+	—	—	Sangoan	
19	68+	50/237 67/4	Ach. I	Ach. II	27 28
100	50	—	—	—	

lagoonal deposit at the back of La Mercy township at the Mhloti mouth rests on a terrace at 34 m (no. 935), but the surface of the gritty clay containing numerous pebbles is at about 38 m; only one unrolled scraper was found among the pebbles.

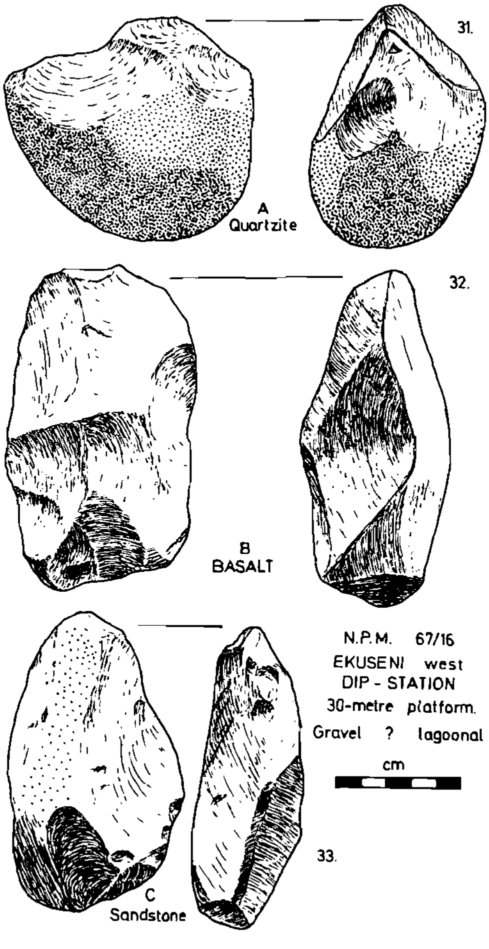
It is reasonable to suppose that a beach at 38 m would be upwarped south of Durban, as is the 30-metre and all the older levels. There are at least three sites at 45–50 m which could belong to it (see Folder 2). The first is a shingle-deposit against a degraded cliff at 44 m at Scottburgh north (no. 031). The second is a bed of water-laid grits at least 3 m thick at 48 m north of Hibberdene (no. 051); no cliff is exposed, but the site is likely to be close to the top of the beach. The third is an exposure of coarse sand and shingle 2 m thick, banked against a cliff about 2½ m high (no. 055), on the Hibberdene–Isipofu road. No artefacts were found at either of the last two sites. At Clansthal the national road cut a terrace without cliff at 40 m (no. 027); on this Swan found a fine unrolled Late Acheulian hand-axe. A deposit of estuarine clay with pebbles behind Turton at 37 m (no. 047) may have lain in a lagoon of this level. At Mzumbi is a shelf carrying pebbles about 38 m (no. 059); it could belong to the marine level under discussion if the exposure, without cliff visible, is in fact several metres below the maximum of the beach. Some very rolled pieces were found among these pebbles in 1950, but have not been recovered so cannot be evaluated or illustrated. South of this point no exposures of a 38-metre level are known; the sites behind Port Edward are best associated with levels at 48 and 30 m.

The well-defined, if widely spaced, exposures of marine sand, rolled pebbles and cliff-bases at about 38 m (allowing for upwarp south of Durban) suggest that there is an independent level at this altitude. This need not mark a separate eustatic interglacial, but may be a halt in the regression from the 48 or the 61-metre level. A 38-metre level has not been observed in other parts of the world. It is unfortunate that artefacts have not been found in association; they would presumably be Early-Middle Acheulian, and probably not diagnostic except in large numbers.

THE 30-METRE LEVEL

A 30-metre sea-level has been recognised in many parts of the world, and after careful studies in western Europe, it is believed to be contemporary with the Mindel-Riss (Holstein) interglacial (i.e. the 100-foot terrace of the Thames). It is well marked in Natal. South of Durban there are few exposures, because in general it is masked by the massive older coastal dunes. It appears to be upwarped 2–3 m, while the 18-metre beach is stable (see Folder 4). It appears therefore that the warping of the Natal south coast, which had been about 40 m since the 155-metre level and 17 m since the 61-metre level, was nearly at an end at the time of the 30-metre beach.

Only one site of this level has yielded diagnostic artefacts. A good many pieces were found at the dip-station on the track to Ekuseni (no. 719, 27° 48'S 32° 19'E, figs. 31–33).



Figs. 31–3.

The rock-shelf is at about 30 m S.L.; no cliff survives, but it must have been near, as at the back is the 61-metre level, no. 720. The Ekuseni gravel does not appear to be marine; its dispersal over the platform does not suggest that it is riverine. So it is probably estuarine or lagoonal, and lies at an altitude very close to contemporary sea-level. The artefacts are of basalt, so difficult to classify. I have recorded

rolled: 5 crude hand-axes
2 pebble-choppers
2 spheroids
flakes
unrolled: a few pieces, probably Sangoan.

Behind Port Edward Hotel is a site inaccurately described and probably carelessly collected by Van Riet Lowe and Breuil.[34] I am indebted to Professor Van Riet Lowe for a copy of his field-notes, and I visited the site in 1949 and again in 1967 with Mr R. C. Walsh. I have thus been able to reconstruct it; most of it is now overgrown. The major part was a shallow sloping valley. In hollows in the rock was red sand (probably dune) with M.S.A. flakes. These were overlain by a ferruginised band with many Sangoan picks. This material was clearly derived on to an erosion-surface which later became lateritised. The slope extended from a rock-platform carrying a few pebbles at 31 m S.L. (no. 12) to a narrow bench at 12 m (no. 13), carrying marine clay and pebbles. Just behind the upper platform is a sharp rise, certainly a cliff. Most of the platform is covered by red dune, from the surface of which must have come the Sangoan on the slope. In the Archaeological Survey at Johannesburg, among a large collection of unrolled artefacts, were several well-rolled hand-axes and one cleaver, clearly from a beach-gravel. Van Riet Lowe noticed only the lower, 12-metre beach; but it is possible that these pieces, which look Middle rather than Late Acheulian, came from the upper platform and had been derived from it on to the slope.

No exposures of the 30-metre level have been noticed north of Ekuseni; they presumably lie concealed beneath the dunes and swamps of the Tongaland plain. Along the western shore of False Bay are several sites, a platform at Lister Point rising to about 30 m (no. 725), a gravel 28 m above River Hluhluwe on the railway which overlies what may be Port Durnford Beds (no. 813, above p. 413), and a river-gravel at about 30 m S.L. at the Nyalazi bridge (28° 12′ 13″S 32° 18′ 05″E); on ferricrete above the last gravel were very late M.S.A. pieces. There is a rock-terrace at about 33 m on River Mfolosi (no. 828), perhaps a little above the estuary. A terrace at the Mhlatuzi bridge (no. 852) is probably estuarine, and carries rolled pebble-tools, apparently derived from a higher beach. A corresponding estuarine terrace probably exists on River Tugela (no. 95). There is a riverine terrace at 33 m above River Mvoti (no. 910) in which I found unrolled Early-Middle Acheulian, and Van Riet Lowe perhaps Early Acheulian (no. 99).[35]

The 30-metre terrace has not been located between Stanger and Durban. It can be seen in the remarkable series on the north bank of River Mgeni (no. 944), and upstream at Kennedy Road in Clare Estate (no. 949). In the sand-pit at Umwabi Road, Isipingo, there is a platform at 33 m with boulders (now removed) and cliff (no. 978).* There is a terrace at 30 m above the river at Illovo Mill (no. 020), one at 37 m on the Ifafa Lagoon (no. 041), and an exposure of beach-sand against a degraded cliff close to Port Shepstone secondary school (no. 068). On the slope below the last have been found unrolled hand-axes.

Most of the sites associated with the 30-metre sea-level are either estuarine or riverine gravels believed to grade to this level. The rarity of true beach-exposures may be due to proximity to the present coast and concealment by dune. It would appear that the 30-metre platform is narrow and less important than the 61-metre or some of the very high platforms. This may be due to the thickness of rock to be destroyed by the 30-metre sea, if we assume that the 48-metre and (?) 38-metre levels represent minor oscillations. It would however seem that what used to be called in Europe the Great Interglacial was of comparatively short duration.

THE 18-METRE BEACH

There is no good evidence for a high sea-level between 30 and 18 m. The 18-metre beach is the Major Emergence which Krige traced round much of the coast of the Cape Province. There has been difficulty in fitting it into the classical sequence of northern interglacials. I do not think that it can be included in either the Holstein or the Eem interglacial. It probably lies between the Riss and the Warthe glaciations, an interglacial not recognised in the homeland of glaciological studies, the Alps, but identified in northern Europe.[36] Geological evidence from Europe does not suggest that it was of long duration; but it may have been remarkably warm, to allow deciduous trees to colonise the north European plain and to raise the oceans.[37]

The most northerly site identified is near the mouth of River Mzeneni (no. 722, 27° 54′S 32° 19′E). Poorly rolled gravel is emerging beneath red dune at about 18 m S.L. The gravel may be riverine or estuarine; no cliff is visible. Rolled flakes and what is probably a core were found with it (fig. 34). On River Nyalazi (no. 815) probably estuarine pebbles are appearing at 21 m on a terrace perhaps cut in Port Durnford Beds. On River Mfolosi a well-marked river-terrace (no. 829), sectioned by the national road, seems to grade to a sea-level about 18 m, and was formerly traceable downstream.

Gravel probably belonging to the 18-metre level has been found at Empangeni (no. 841), and there is a corresponding river-terrace at the Mhlatuzi bridge. There are fragments of a terrace at 18–20 m close to the Tugela mouth (no. 97), carrying large pebbles with chatter-marks. There is an 18-metre terrace also on River Mvoti (no. 911).

On the north bank of River Mhloti is a steeply dipping rock-surface from 17 to 10 m S.L. (no. 936). It is covered by pebbles, grit and sand, apparently *in situ*. Among the pebbles

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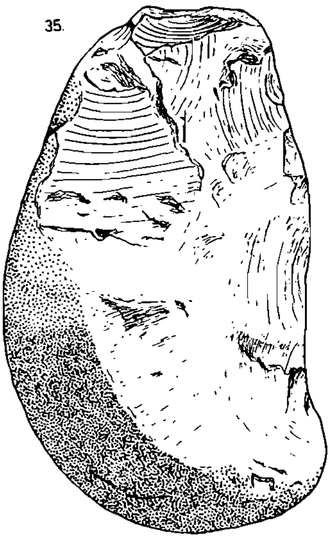
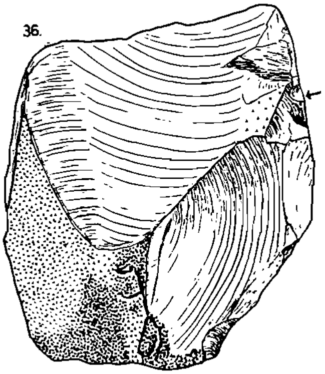
* Although this paper is concerned with marine platforms and not with overlying coastal dunes, it may be mentioned that the Umwabi Road section disproves Maud's contention that the 'first aeolianite', earlier than the 9-metre beach, is a hard white cemented sandstone, and the Berea red sands all belong to the 'second aeolianite', which is later than the 9-metre beach. At Umwabi Road there are two red dunes, separated by an unconformity. The lower is banked against the cliff of the 33-metre beach, the second is the high red dune which occurs all across Durban and down the coast. Atypical artefacts, one of vaguely Acheulian type, were found at the unconformity. Thus the 'first aeolianite' can weather to red sand as well as the second, unless indeed the older dune at Umwabi Road is even earlier than the cemented sandstone forming the base of the Bluff. Red dunes occur in Tongaland so far inland that they cannot be derived from any recent marine regression, but must have been deposited in Early or at latest in Early Middle Pleistocene times, when the shore was not far from them.

35.



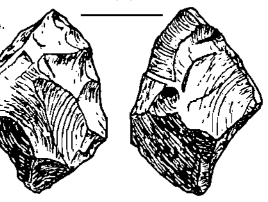
N.P.M. 67/23: UMHLOTI MOUTH NORTH BANK
in beach-grit on platform dipping from 16 m.
Quartzite, lower side pebble-surface; 8 cm
thick

36.



N.P.M. 50/234: UMLAAS BRIDGE
apparently lagoonal gravel c. 14 m M.S.L.
Quartzite, lower side flake-surface; 6 cm
thick

34.



N.P.M. 67/12: MZENENI SISAL-MILL
Beach-gravel at 16+ m M.S.L.; lightly rolled

ARTEFACTS from 18 - metre BEACH
cm

Figs. 34–6.

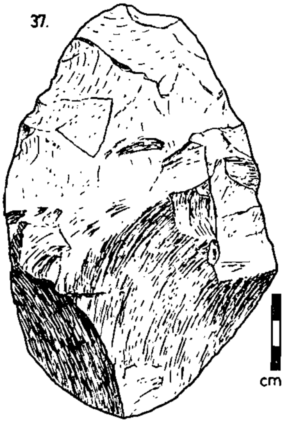
was found a large rolled hand-axe, not typical (fig. 35). There is no cliff. The rock-surface may be the bed of the river-channel; it dips too steeply to be a normal beach-platform. If so, it probably belongs to the 18-metre level.

The 18-metre terrace is not recognisable on River Mgeni except as a probably riverine gravel in Klein Zeekoe Valley (no. 950), some miles above the mouth. It reappears, without cliff, on a road-cutting at Amanzimtoti station (no. 013). Between these two points I have provisionally assigned to this level the gravel at the Mlaas bridge (no. 967, 29° 57′ 16″S 30° 56′ 40″E). The site is now entirely sealed by road-works, and it has not been possible to check observations made in 1950. In a new channel cut where River Mlaas debouches into the plain, there appeared beneath grey silt a deltaic gravel, apparently at the base of a rock-bar at the mouth of the valley. In 1950 I estimated the altitude as 14 m M.S.L.; in 1967 it appeared to be 15–16 m, from the indications in my field-notes. The gravel dipped rapidly eastward, presumably into the bed of the Durban Harbour lagoon which formerly was much larger than today; at the railway-bridge 200 metres east of the new cut and the road to Lamont it was a good deal lower than 14 m. We cannot tell if at that date the surface of the lagoon was at sea-level. It seems likely that the gravel was deposited in shallow water, so a corresponding sea-level of about 18 m is reasonable.

Cramb[38] recorded Old Stone Age artefacts beside the Mlaas, three miles from the sea, on a river-terrace cut in Ecca shale capped by red sand. He probably saw the highest exposure of this deltaic gravel on the Lamont road, or the river-gravel just above it. In 1950 artefacts were collected from the gravel:

well rolled and probably derived from an older beach:	1 hand-axe 1 core 1 piece, not certainly an artefact
lightly rolled:	1 uniface hand-axe (fig. 37) 1 cleaver (fig. 36)
unrolled:	several hand-axes, 1 side-struck 2 cleavers, 1 side-struck flaked pieces of chopper-type 2 probable cores 5 flakes.

37.



N.P.M.50/234 : UMLAAS BRIDGE
Quartzite, lower side pebble-surface;
6·5 cm thick

Fig. 37.

Some of the unrolled pieces seem to be Late Acheulian, one or two may be Sangoan; degenerate Sangoan was found on the red sand overlying the gravel. The lightly rolled pieces appear to be Late rather than Middle Acheulian; so it appears that the gravel was deposited during Late Acheulian times, a reasonable suggestion for the 18-metre sea-level.

Several exposures of pebbles near the mouth of River Illovo may be marine, detrital marine or estuarine. There are no cliffs, but some seem to belong to or to be derived from the 18-metre level. On one (30° 06′ 16″S 30° 51′ 11″E) was found a small rolled hand-axe.

In a cutting on the north bank of the Mgababa lagoon (no. 023) pebbles appear at 18 m S.L. beneath red sand. No cliff is exposed, but it may be very near. A number of dolerite pieces resemble heavily rolled Late Acheulian hand-axes, but are too worn to be confidently claimed as artefacts.

The rock-bench on which rests the interesting L.S.A. section at Green Point[39] is at 18 m (no. 028). A short way south, just north of Amahlongwa Lagoon (no. 029), Swan collected on this terrace at about 15 m unrolled dolerite pieces which appear Late Acheulian, two picks, cleaver, pebble-chopper, and two slabs of shale. They are in the Archaeological Survey at Johannesburg. The 18-metre bench reappears on both banks of the river at Scottburgh (nos. 032, 034), especially on the floor of the car-park at Scottburgh Point. There is an exposure of the lagoon-deposit of this level just north of Kelso (no. 080, pl. 2).

Between Scottburgh and the neighbourhood of Port Shepstone the only exposures of the 18-metre beach, with sand and shingle resting on a rock-bench, are near Hibberdene (no. 052). There is a platform without cliff at 18 m at Port Shepstone lighthouse, capped by pebbles and marine grit (no. 066), and an estuarine terrace in the Mbango valley just south of the town (no. 069). Between Port Shepstone and River Mtamvuna there is a small exposure at Uvongo (no. 070) and a terrace with boulders on River Mpenjati (no. 076). These two are the only exposures in Natal recorded by Krige.[40]

Kelso, no. 080; lagoon-gravel at 18 m.

TABLE 2, FOLDERS 3–4

Site no.	*Altitude*	*Artefact no.*	*Industry R*	*Industry U*	*Ill. fig.*
73	3·6+	—	—	—	
719	30	67/16	Ach. ? II	Sangoan	31–33
722	18±	67/12	Late Ach. or Faur.	—	34
723	10−	—	—	—	
27° 56′	24→12	—	—	—	
27° 56′	5	—	atypical	—	
726	3	—	—	—	
725	30+	—	—	—	
81	2·6+	—	—	—	
28° 01′	10±	—	—	—	
87	9	50/387	—	M.S.A.	
88	3	—	—	—	
83	9+	—	—	—	
84	2·6	—	—	—	
810	2+	—	—	—	
813	37→28	50/363	atypical	Sangoan	
814	18→9	50/360	Middle Ach.	Late Ach.	38–40
815	21+	50/351	—	M.S.A.	
28° 12′	30−	50/353	—	M.S.A.	
816	8+	50/379	—	M.S.A.	
817	8+	—	—	—	
818	3·5	—	—	—	
820	6+	—	—	—	
821	3·5+	—	—	—	
828	33	—	—	—	
829	33→20	—	—	Sangoan	
830	23→10	50/358	? pebble-tool	M.S.A.	
28° 28′	24→18	—	—	—	
833	37−	—	—	—	
837	38	† 50/374	—	M.S.A.	
28° 41′	17→9	50/370	—	M.S.A.	
841	20+	† 48/47	—	M.S.A.	
839	9	68/1 68/21	—	Sangoan	
840	2·8+	—	—	—	
838	30±	—	—	—	
847	3	—	—	—	
852	30	50/376	†pebble-tools	M.S.A.	
28° 50′	16−	50/375	†pebble-tools	—	
848	8−	—	—	—	
91	33±	—	—	—	
95	27±	—	—	Sangoan	
29° 12′	27±	—	—	—	
29° 12′	5−	—	—	—	
96	8	—	—	—	
29° 13′	11+	—	—	—	
97	20±	—	—	—	
29° 14′	→9	—	—	—	
98	38	48/64	pebble-chopper	Sangoan	
910	40→33	50/474	†Early Ach.	—	
911	25→18	† 50/473	—	Early Ach.	
29° 23′	12→6	—	—	—	
29° 23′	10→3·5	—	—	—	
912	9+	—	—	—	
913	2·5	—	—	—	
915	17+	—	—	—	
916	3	—	—	—	
917	8+	—	—	—	
918	3	—	—	—	
922	9+	—	—	—	
920	3	—	—	—	
29° 33′	24→12	50/530	flakes	Late Ach.	
935	34+	67/22	—	? Sangoan	

Site no.	*Altitude*	*Artefact no.*	*Industry R*	*Industry U*	*Ill. fig.*
29° 38′	→9	—	—	—	
29° 38′	→4	—	—	—	
936	16+	67/23	Ach.	—	35
938	6+	—	—	—	
975	12	—	—	—	
950	18+	—	—	—	
944	30+	—	—	—	
949	29	48/69	—	Ach. or San.	
945	12+	—	—	—	
946	8	48/63	flakes	Sangoan	
29° 48′	6·5	—	—	—	
947	3	—	—	—	
952	8+	—	—	—	pl. 3
963	6±	—	Sangoan?	Sangoan	
964	4	—	—	—	
967	14±→18	50/234	Ach. III	Ach. III	36 37
970	6+	—	Sangoan	—	
978	33	67/24	—	Late Ach.	
971	3	—	—	—	
01	6+	—	—	—	
03	6+	—	—	—	
07	7+	—	—	—	
013	18+	—	—	—	
078	9±	—	—	—	
015	13+	—	—	—	
016	24+	—	—	—	
020	39→30	—	—	Sangoan	
30° 06′	21+	—	—	—	
30° 06′	15+	50/236	Early Ach.	Sangoan	
30° 06′	15→9	—	—	—	
30° 07′	24+	—	—	—	
30° 07′	2·6	—	—	—	
30° 08′	6±	50/225	—	M.S.A.	
023	18+	48/4	? Late Ach.	Sangoan	
30° 10′	4·8+	—	—	L.S.A.	
025	6	50/235 67/5	Faur.	M.S.A.	41 42
30° 12′	8−	—	—	—	
30° 12′	5−	—	—	—	
027	40+	—	—	Late Ach.	
028	18+	50/222	—	M.S.A.	
029	16+	—	—	Ach.	
30° 16′	6	—	—	—	
033	36+	50/205	—	flakes	
032	18	—	—	—	
034	18	48/8	—	Sangoan	
035	6	—	—	—	
080	18	—	—	—	pl. 2
30° 22′	8±	50/226	—	Sangoan	
041	37−	—	—	—	
047	37	—	—	Sangoan	
30° 31′	10	—	—	—	
048	6	—	—	—	
30° 33′	6	—	—	—	
052	18+	—	—	—	
30° 35′	18+	—	—	—	
056	8	—	—	—	
057	11	—	—	—	
30° 37′	9	—	—	—	
059	36+	50/242	† ? Early Ach.	M.S.A.	
30° 38′	6	—	—	—	
050	6+	—	—	—	
061	3	—	—	—	
063	22	—	—	—	
30° 42′	6	—	—	—	

Site no.	*Altitude*	*Artefact no.*	*Industry R*	*Industry U*	*Ill. fig.*
065	4·5±	—	—	—	
066	18+	—	—	—	
30° 44′	9±	—	—	—	
068	32	50/206	—	Middle or Late Ach.	
069	18	—	—	—	
070	18	—	—	—	
071	6	—	—	—	
072	3·8	—	—	—	
073	15→10	—	—	—	
076	18	—	—	—	
104	6·6	—	—	—	
105	3·3	—	—	—	
107	9	—	—	—	
12	31	—	Ach. II	Sangoan	
13	12	—	—	—	
14	3·5	—	—	—	
101	34	—	—	—	

THE 9-METRE AND THE 6-METRE BEACHES

I have recorded in the vertical section (Folders 3 and 4) a few exposures at 11–12 m (about 40 ft). It is not possible to guarantee that measurements have been accurate, and nearly all the sites appear to be estuarine, so may be higher than the corresponding sea-level. I am inclined to associate with the 9-metre level the rock-bench on the north bank of River Mgeni just above Athlone Bridge (about 12 m, no. 945); the terrace near Blackburn Bridge on River Mhlanga (no. 975); the 10-metre terrace on River Mzeneni (no. 723); and a river-gravel at Tesco halt (29° 33′ 00″S 31° 08′ 02″E) at 24 m S.L. and 12 m above River Tongaat. In the last were found artefacts:

heavily rolled:	1 chopper broken pebble
lightly rolled:	2 utilised flakes large core
unrolled:	large cleaver large end-scraper.

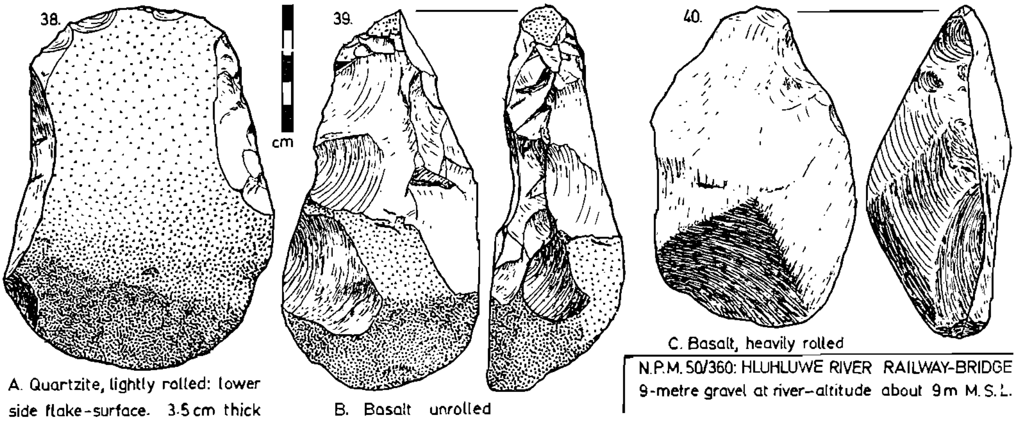
The only diagnostic pieces are Late Acheulian and may belong to the 9-metre level or to a phase of downcutting during the eustatic low sea-level between the 18-metre and 9-metre benches.

Two sites at about 12 m S.L. yield marine shingle and sand. One, at Tugela Mouth, is probably not *in situ* but derived from the 18-metre bench beneath dune. On the other, at Mzumbi (no. 057), beach-material two metres thick rests on a platform at 11 m and is banked up as if the cliff is near; but one cannot deduce the corresponding sea-level. The 12-metre platform at Port Edward (no. 13, above p. 425) may have been inaccurately measured.

Thus there seems to have been no transgression between 18 m (Krige's Major Emergence) and 9 m (Minor Emergence).

The 9-metre terrace may be traced from False Bay (no. 87 at Higg's Point) and the more easterly St. Lucia Lake (Hell's Gates and The Cove, no. 83; Charter's Creek, no. 816).

It may be seen also, cut in dune-rock, on the present coast at Bats' Cave (no. 817, 28° 14'S 32° 31'E). To it must belong the 9-metre terrace above River Hluhluwe at the bridge (no. 814). From this gravel many artefacts have been collected (figs. 38–40):



A. Quartzite, lightly rolled: lower side flake-surface. 3·5 cm thick

B. Basalt unrolled

C. Basalt, heavily rolled

N.P.M. 50/360: HLUHLUWE RIVER RAILWAY-BRIDGE
9-metre gravel at river-altitude about 9 m M.S.L.

Figs. 38–40.

heavily rolled: 1 large core
2 rough hand-axes
2 large flakes used as choppers
3 pebble-choppers
lightly rolled, quartzite: 1 rough pick
2 choppers
1 end-struck cleaver
lightly rolled, basalt: 1 pick
2 flake-tools
unrolled, lydianite: amorphous choppers and flake-tools, probably M.S.A.

The lightly rolled pieces indicate that the gravel belongs to the Late Acheulian stage.

River-gravel near Mpangani Lake and close to the railway-bridge on the south bank of River Mfolosi (no. 830) probably graded to the 9-metre level. It yielded two amorphous rolled pieces, which could well have been derived from a higher beach. There are corresponding river-terraces on the railway near River Enseleni and on Rivers Mhlatuzi (no. 848), Tugela (no. 96) and Sinkwazi. On the promontory near Salt Rock a bench at 9–10 m may be recognised at several places (nos. 912, 917, 922). At no exposure is the cliff-base visible, but it was probably very near.

On the north bank of River Mgeni downstream from Athlone Bridge is a rock-cut bench at about 8 m (no. 946). It carries white clay and a few pebbles. It probably belongs to the 9-metre rather than the 6-metre level.

Just as the 9-metre bench was cut in dune-rock on the outer side of St. Lucia Lake, it may be traced between a hard calcified dune and a less cemented white dune along the outer edge of Durban Bluff. The cliff is nowhere visible, the occurrences are at 7–8 m. I

Cave Rock, Durban, no. 952. Beach at 7–8 m.

have seen them at Cave Rock (no. 952, pl. 3), Reunion North and South (no. 970), Isipingo Headland (no. 01), Tiger Rocks (no. 03), and the Mbogintwini mouth (no. 07); nos. 01 and 03 are at 6 m M.S.L., and may be near the top of a 6-metre bench rather than some way down the 9-metre (see below). The underlying dune has in places slumped, as at Cave Rock and Reunion North; the slump is truncated by the beach. In the beach are numerous *Crassostrea margaritacea** and perhaps other fauna (not yet reported). At Reunion there was found in it a lightly rolled Sangoan pick and two rolled pebble-choppers.

An 8–9 metre bench is reported at Amanzimtoti (no. 078).[41] It is no longer traceable because the area is altered by building. There is a spur of this height near the mouth of River Illovo. Beach-rock at Renishaw, recorded by Fair at 8 m S.L., has also disappeared under modern developments.

A rock-bench was seen by Fair and myself at Hibberdene (no. 056). A terrace at 10 m at Turton, a short way to the north, can no longer be identified.

A terrace at 9 m S.L. is known in many parts of the world, and is generally believed to correspond to the Eem or Riss-Würm interglacial.

Although I was unable to identify it north of River Mvoti, I think that there is evidence from many parts of South Africa for a marine terrace at 6 m. It may be the wide flat, cut perhaps in Port Durnford Beds to 5–6 m S.L., at Malakatana Bay (no. 820).

Opposite Beach Hotel, Mhloti, is a platform at 6 m (no. 938). It is said that an oyster-bed was formerly visible on it, and Kent claimed[42] that it was overlain by calcified dune, which has now been removed, probably by building. At the back of Durban Bluff, close to the new artificial mouth of River Mlaas, is a terrace with a few pebbles, now mostly destroyed (no. 963). Mr R. C. Walsh, who examined the section when intact, has stated that he found on it a lightly rolled Sangoan piece. There is also unrolled Sangoan there.

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* Identified by Mr. R. N. Kilburn of East London Museum.

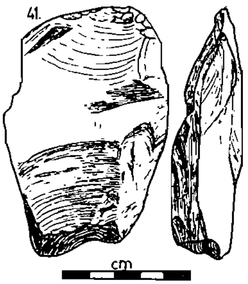
From Tiger Rocks, Beater reports[43] three 'abraded' M.S.A. pieces, which he has informed me are not truly water-rolled. His account is not very precise; it appears that they lay at the base of dune-rock just above a beach-deposit. He claims that the beach belongs to a transgression to 8½ m; but for this there is no direct evidence, as nothing is preserved above 6 m. The artefacts would fit better a 6-metre intra-Würm level.

On the south bank of the Mzimbazi lagoon near Karridene (30° 07′ 45″S 30° 50′ 37″E) and to the north of Kelso station there were formerly visible on road-cuttings lines of pebbly ferricrete in the red dune. The ferricrete must have formed after the dune had assumed roughly its present shape. At Karridene it ended at about 6m M.S.L. at a horizontal layer of dark grey sand; at Kelso it ended at 6–7 m M.S.L. These levels may mark the surfaces of the lagoons during a transgression which was probably that of 6 m. Unfortunately, both sites have been destroyed in road-works. At both a good many pieces of M.S.A. and a few Sangoan picks were found in the ferricrete. Above the ferricrete at Kelso was white dune-sand containing Wilton artefacts.[39]

At the mouth of River Ingane (no. 025) is a narrow terrace carrying pebbles, beneath red dune on which is M.S.A. The altitude of the terrace is 5·5–6 m. Among the gravel have been found several artefacts:

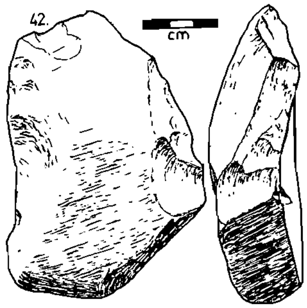
1 small end-struck cleaver of shale, slightly rolled, perhaps Fauresmith (fig. 41)
1 pebble split to form a pick, lightly rolled
1 heavily rolled flake, trimmed as a side-scraper and again lightly rolled (fig. 42)
not found *in situ*, 2 heavily rolled pieces of dolerite, one of them probably a rough cleaver.

There are few convincing sites of the 6-metre terrace south of River Mkomaas. There is apparently a terrace at Park Rynie (no. 035) and at the mouth of River Makosi (no. 048).



N.P.M.67/5: shale cleaver
INGANE MOUTH: 5·5-m terrace

Fig. 41



N.P.M. 50/235. INGANE MOUTH, 5·5m bench
Dolerite, heavily rolled flake resharpened
as side-scraper and again rolled

Fig. 42

Fair records fossil bay-bars at 6 m, which are still to be seen, at the mouths of Rivers Mhlungwa (no. 056), Mzimai, Injambili, Idomba (no. 060) and Mhlangakulu. There is a narrow terrace at 6 m on the sea-front at Uvongo (no. 071).

The evidence from Natal for an independent 6-metre terrace is not entirely convincing. At three sites it appears to exist alongside the 9-metre terrace, and presumably marks a separate transgression. At the mouth of River Mgeni, beside the 8-metre rock-bench, a beach overlying estuarine silts was noticed at 6 m at the time of the construction of the national road. On River Mkomaas Maud noticed terraces at 5 and 8 m. At Leisure Bay there is a rock-terrace at 6·6 M.S.L. (no. 104) and a terrace on the promontory to the south at 9 m (no. 107).

In the Transkei and Ciskei and near Algoa Bay benches with cliffs at about 6 m were noticed at many sites, and benches of probably both the 6- and 9-metre levels were observed on traverses at Port Grosvenor (cliff-bases 5·5 and 7·5 m), Cape Hermes (6·5 and 9·5 m), Mazeppa (6 and 9 m), Seal Point (6 and 9 m), Kromme mouth (6 and 9 m) and Jeffreys Bay (6 and 10 m). The 6-metre terrace is probably what Zeuner calls Epimonastirian. Radiocarbon dates from many parts of the world suggest that it marks a short intra-Würm transgression corresponding to the Paudorf or Hengelo interstadial.[44] If the 9-metre terrace belongs to the Eem interglacial, it will lie beyond the limits of radiocarbon.

In the Paudorf interstadial the European ice retreated to central Sweden,[45] though there was still ice in Wales,[46] and Van der Hammen considers that European temperatures were well below those of an interglacial.[47] Radiocarbon dates for a sea-level higher than present have been obtained from the southern and from low latitudes of the Northern Hemisphere on apparently stable coasts:

South Africa,	Sedgefield Y–468 37700 ± 2000
	probably Nahoon Point SR–83 29090 $^{+410}_{-390}$[48]
	other dates not yet published.
Australia,	Western Australia 35000 ± 3700[49]
	eight dates in this range from the south and east costs[50]
Senegal–Mauritania,	T–464 31400 ± 1700
	T–536 31100 ± 1200
	I–2771 31050 $^{+1400}_{-1250}$
	I–2776 32500 $^{+2150}_{-1800}$
Mexico,	beach-rock at 1 m M.S.L. Tx–155 35200 ± 2400
Texas coast,	shells at 15 m depth, implying sea-level above this,
	LJ–383 26900 ± 1800
	LJ–526 32500 ± 3500
Sarawak,	Ostrea from a cave at the highest Late Pleistocene sea-level, UCLA-957 37500 ± 1600.

Dates from Hawaii are not included, as this archipelago may have been unstable.

It is difficult to regard all these and other unpublished dates as from contaminated specimens, as they are grouped between 40000 and 29000. There are few dates between 29000 and 11000.

There is also geological and archaeological evidence for an intra-Würm high sea-level, though it is not so precise as that of radiocarbon dates. Zeuner's Epimonastirian was identified at Alexandria and on the Atlantic coast;[51] his evidence from Alexandria has been disputed by Butzer.[52] At Camp Franchet d'Esperey (Algeria) Aterian pieces lay immediately on a beach;[53] it is most unlikely that this industry started as early as the Eem interglacial. I have mentioned Beater's find at Tiger Rocks (Isipingo). The date for Nahoon Point is of dune-rock which immediately overlies a beach with unrolled M.S.A. pieces.[48, 54]

THE HOLOCENE BEACHES

Claims have been made for a number of levels at 4 m and under. Caution should be used regarding low river-terraces and flood-plains, as a single flood of no eustatic significance may build or destroy an alluvial terrace up to 2 m high. Along the coast there are undoubted platforms and cliffs at several levels down to below modern sea-level. But their altitudes vary by so little that it is impossible to correlate and date them without radiocarbon. They are often cut in carbonate-rock, beach- or dune-rock; so radiocarbon would date not the terrace but the rock into which it was incised. Fairbridge[55] has been able, by comparing levels and dates from many parts of the world, to construct a sequence of holocene fluctuations. But we need independent evidence to establish this sequence in South Africa.

My observations in Natal and as far as Port Elizabeth indicate two regular levels, one at 3–4 m, probably of the Flandrian transgression about 5000 years B.P. (which I have plotted on Folders 3 and 4), and one at about 1·5 m M.S.L., above the range of modern tides. Both of them may represent more than one minor transgression. There are also low levels, apparently older than the present phase and some being demolished by the sea today. It is not worth while to list or map these in detail.

The 3–4 metre level is the best marked, but datable material has not been found in association with it in this country. It belongs to the climatic optimum of the Holocene, when widespread melting of glaciers caused eustatic rise of sea-level. It has been observed in many parts of the world, especially on steep coasts with deep water offshore; on flat coasts with wide foreshores, such as the Rhine delta and the Gulf of Mexico, it is not found, and radiocarbon dates indicate a sea-level about 5000 B.P. below -2 m instead of $+3$ m.[56] The complex mechanism of isostatic loading on different types of coast has not yet been fully determined.

As the Tongaland coast has been little explored and is difficult of access, the only site found along it is a terrace cut in beach-rock and exposed up to 3·6 m without cliff at Lala Nek (no. 73). Along the shores of False Bay and St. Lucia Lake there are low terraces and beaches with cliff-base about 3 m M.S.L. (Lister Point no. 726; Hell's Gates no. 81; The Cove no. 84; Higg's Point no. 88). They occur also on the outer calcified dune at Bats' Cave (no. 818) and Mission Rock (no. 821). On the low dune-covered coast between River Mfolosi and the rocky headlands near Salt Rock (nos. 913, 916, 918, 920) there is a long gap, not very satisfactorily bridged by apparent lagoonal flats at Richards Bay (no. 840) and River Mhlatuzi (no. 847). This stretch may have been affected by shallow-water isostatic adjustment, especially by an outward bulge in the isobaths presumed to be due to silts poured into the sea by River Tugela and the big rivers of Lower Zululand.

There are, among the road-works at the Mgeni mouth, traces of a 3-metre terrace (no. 947). A terrace at 4 m, independent of the 6-metre level, occurs on the seaward face of Durban Bluff (nos. 964, 971). Between Durban and Port Shepstone hardly a trace of the 3-metre sea-level or of river-terraces grading to it has been recorded. This may be due to lack of detailed survey, and to the difficulty of evaluating benches on a coast which has been much developed for holiday-resorts. The first clear trace of a 4-metre terrace with degraded cliff is at Uvongo (no. 072). It may be seen also at Leisure Bay (no. 105) and at Port Edward (no. 14).

There are many signs in Natal of a terrace between 1·4 and 1·9 m. This level, as well as the 3–4 metre level, has been frequently recorded on the rocky and unspoiled coasts of the Transkei and Ciskei (1·5-metre level recorded at 23 sites in the Transkei and 19 in the Ciskei; 3–4 metre level, 21 sites in the Transkei, 17 in the Ciskei).

Information has been published about very low levels on River Mgeni.[57] Once the river had started to incise the older rocks of the coastal scarp immediately after the 60-metre sea-level, it cut a gorge grading to contemporary sea-level and continued to follow that gorge, with aggradation of silt at times when sea-level rose. Rock was met at the railway-bridge at −47 m; we do not know if this figure indicates the base of the incision during the last glaciation or if it had been reached during an earlier low level. East of the coastal scarp the entrenched valley trended south of the present channel, which has been established only since the present coastal plain was formed under conditions of holocene high sea-level, and probably quite recently in the Holocene. The channel today hugs what must have been a steep scarp on the northern edge of the coastal plain, and so silhouettes a series of marine terraces above Riverside Road which presumably continue south of the river beneath the thick covering of Berea red sands. The gorge at the railway-bridge would not have been incised to the maximum depth of sea-level, and was at some distance from the coast at that time. The regression can be roughly estimated from the occurrence of sub-aerial dune-rock at Durban Bluff down to at least −90 m.

There is little doubt that other Natal estuaries are deeply entrenched and filled with sediment. Indications may have been found within Durban, and probably in building the new bridges on the south coast. River Mtamvuna is 17 m deep at the mouth.[40] A boring for the new bridge on River Mfolosi, from probably 10–15 m above sea-level, failed to reach rock at 62 m. So far as I know, information is buried in the records of the South African Railways and the Natal Roads Department, and has not been published. There may be a little information from north of Durban; but in general road and railway have run farther inland, and have crossed rivers above or near the heads of their estuaries.

CONCLUSIONS

As Dr Maud's paper was published not long after mine was completed, I am able to take account of his revised rather than of his provisional conclusions. I do not want to speak in detail of the coastal aeolianites which he discusses, because to them archaeological evidence can assign only limiting dates. Artefacts have never been found within the dunes, only beneath and on them. Even where deep sections are exposed, the dune-sands normally appear structureless. At Burman's Bush, Durban, where for an unknown reason patches of calcification have survived, there are signs of cross-bedding and probably of a crest somewhat east of the present North Ridge Road.

Although some of the dunes in Zululand and Tongaland seem to be of considerable antiquity, in Natal, where they occur fairly close to the coast, they overlie almost all the marine terraces down to 9 m. There is occasionally red sand also on the 6-metre terrace. One may therefore tentatively reconstruct the sequence:

Older dunes of several stages	
9-metre shoreline, probably Eem interglacial; removal of most of the older dune-sands	Late Acheulian
Rapid and vigorous dune-formation	Uninhabited
Vegetation and human occupation of dune-crests	Sangoan
Contemporary with the last, or later, 6-metre shoreline; a little redistribution of sand on crests and slopes	
Reoccupation of dune-crests, probably in the eustatic low of Würm II.	M.S.A.

In the Cape Province, where coastal dunes have not undergone decalcification, they frequently overlie the 6-metre terrace and occasionally the 4-metre.

The evidence presented from marine platforms indicates:

(1) Altitude cannot be used to determine age. Only when probable age has been fixed by zone-fossils, may altitudes be compared with those of marine terraces in other parts of the world.

(2) The Zululand coast has been nearly stable during the Pleistocene, but there has been upwarping in Natal as late as the Late Middle Pleistocene (30-metre bench probably = Holstein interglacial). On this point I disagree with Maud. In parts of the southern Cape, near Knysna and probably near Cape Town, there has been tectonic movement until the end of the Middle Pleistocene. In other parts, around Algoa Bay and near Riversdale, there has probably been stability, and the levels may correspond with those of Zululand; but studies in these regions are incomplete.

(3) Artefacts in marine gravels are as valuable zone-fossils as fauna. Both artefacts and fauna may be derived into later beds. Fauna has the disadvantage that it changes slowly on ocean-coasts (not on inland seas); thus only two faunal stages can be identified in all the pleistocene marine levels in Morocco. Single or small groups of artefacts are difficult to assign to a definite stage. However, the appearance of the hand-axe can, with fair plausibility, be correlated with the Cromer interglacial in Natal, in parts of the Mediterranean, and in western Europe. The development of this tool cannot at present in South Africa be tied to subsequent transgressions. Pleistocene geologists ignore artefacts at their peril.

(4) I cannot identify Maud's 12-metre beach in Natal, nor did Krige notice this level in the Cape Province. It is not known in other parts of the world.

(5) Maud probably overestimates the number of low sea-levels (holocene). It would have been prudent to glance at evidence from other parts of the world. Natal and the Cape

have steep coasts of the type that Fairbridge has studied. From radiocarbon-dates which must be accepted critically, Fairbridge identified three holocene transgressions, of which the first and second were to about the same level and cannot be distinguished by normal geological methods. Particularly on the Cape coast I have frequently seen platforms and cliffs at *c.* 3·5 and *c.* 1·5 m, but rarely at other levels above modern tidal range. The picture of two holocene levels higher than the present may oversimplify the fluctuations; but until close dating-accuracy is attainable, it is probably justifiable.

(6) My figures for the higher marine levels differ from Maud's. A dumpy level is seldom practicable for 30 m and over, and available maps do not give sufficient accuracy. He does not claim to have used an aneroid or altimeter. Nevertheless, I do not disagree fundamentally with his levels. I would correlate as follows:

Maud	*Davies*
33 metres	30 metres
not identified	38 ? true level
45	48
70	61
not identified	73
not identified	82
115	110
170	155

It would not be worth while to notice a recent article by King (1966. *Trans. Geological Society of South Africa* **69**: 201–210), were it not published in a journal which maintains a high scientific standard. From a group of beds, which range in date from perhaps the Cretaceous (Clairwood Quarry) to Late Pleistocene (Durban Bluff) and in altitude over nearly 100 m, he postulates a pliocene transgression. He argues from Foraminifera which have been examined by experts. But their cautious statements, 'probably pliocene' or 'pliocene or younger' or 'indeterminate', he alters to pliocene. Geologists would be well advised to take account of stratigraphical and archaeological as well as microfaunal evidence.

The deposits cited in the Mfolosi valley are among those assigned by Maud to the Port Durnford series. I have shewn that this series is ill defined. It may cover a number of transgressions, and though the type-locality probably belongs to the 30-metre stage, deeper beds, farther inland, could well date to any part of the Pleistocene or to the Pliocene. Yet the fauna which King lists from this area is that which the experts assign with least confidence to the Pliocene, and all the samples contain miocene species derived from underlying deposits.

ACKNOWLEDGEMENTS

The work on beaches in Natal was carried out at my own expense. The survey of those in the Transkei and Ciskei, to which allusion is occasionally made, was financed by a grant-in-aid from the C.S.I.R. in 1968. I wish particularly to thank for their assistance Mr R. C. Walsh of Durban, who came with me on most of my trips in Natal and Zululand; Dr R. R. Maud of Durban, who put at my disposal the typescript of his own paper, and

this enabled me to identify a number of sites which he had discovered and I did not know; Mr D Lewis-Williams of Kearsney College, who has come with me on occasions in 1967; Professor C. van Riet Lowe, who accompanied me to Zululand in 1950; Professor R. Fairbridge of Columbia University and Dr H. Richards of Philadelphia for their encouragement in my work on behalf of the International Quaternary Association.

KEYS TO THE FOLDERS

The tables of sites, illustrating the vertical maps on Folders 1–4, are explained on pp. 406–7 of the text.

N.B. Gravels of River Usutu in Ndumu Game Reserve at 50, 25 and 13 m above the overflow of the river are not recorded, as the occurrences are far from the sea, and the levels would have to be traced across the Mozambique plain. Although sites recorded on River Pongola are even farther from the mouth, there is reason to think that these gravels are actually marine, and belong to a period when at high sea-levels the whole Tongaland plain was submerged. Whether at low sea-levels before or after these transgressions the river pursued its present course over the emerged shelf or at times flowed into Lake Sibayi is a problem which cannot be discussed here. The area of St Lucia Lake apparently illustrates the same phenomenon in a less mature stage. The same fairly recent high sea-levels are found on a single traverse right across the area, both on False Bay, on St Lucia Lake and on the present coast.

Sites on Folder 3 regarded as probably exposures of Port Durnford Beds are not included in these tables, but are listed on p. 413 of the text.

NOTES

[1] Maud, *Zeitschrift für Geomorphologie*; McCarthy, *Geological Society of South Africa Transactions*. Maud's paper has been published since the completion of my text in Supplementband 7 (1968).

[2] *S. Afr. Archaeol. Bull.* **6** 24 (1951): 107–12.

[3] Thompson, 1942. *Trans. geol. Soc. S. Afr.* **45**: 37.

[4] This dating implies that in South Africa there has been continued emergence, perhaps tectonic, since the Later Tertiary. In other parts of the world believed to be stable, pliocene sea-level was low, and there was a large transgression at the beginning of the Pleistocene. See Webb & Tessmann, *Science* **156** 3773: 379 on Florida.

[5] Paper delivered at VI Panafrican Prehistoric Congress at Dakar, December 1967, unpublished.

[6] Measurements were made by Mr Walsh with an aircraft-altimeter, which could be read accurately to 5 ft (1½ m), or when I was alone, with a Steward aneroid which can be read accurately to 10 ft (3 m).
The aneroid was set at sea-level, a station or a trigonometrical beacon every morning and at intervals during the day, whenever opportunity offered. If there had been more than 10 ft variation since the last setting, the figures most recently read were adjusted or read afresh. When the sea-breeze starts, no measurement can be taken more than half an hour after setting; on days with atmospheric depression no measurements can be taken. The work was done in the season of predominantly steady fine weather. Shore-rocks or the immediate rise from the shore could often be measured from high-tide mark on one's own height; 3 ft (90 cm) were allowed for difference between spring high tide and Mean sea-level.

[7] See Frankel & Bayliss, 1966. *Journal of Sedimentary Petrology* **36**: 193.

[8] Davies, 1954. *S. Afr. Archaeol. Bull.* **9**: 62, fig. 2.

[9] King & Maud, *South African Geological Survey Bulletin* **42**.

[10] See Remy, 1958. *Eiszeitalter und Gegenwart* **9**: 83; Altehenger, ibid.: 104.

[11] Kaiser, *VI Inqua Report*, vol. 1, p. 185.

[12] *Geological Survey of Zululand, Third Report*, p. 121.

[13] King, 1953. *Trans. geol. Soc. S. Afr.* **56**: 61.

[14] *Cape Provincial Museums Annals* **2** (1962): 37.

[15] This well-known and very informative section has not been illustrated in this paper, because there are good photographs published by Maud, l.c., pl. 2; and by Davies, *Natal Regional Survey* (ed. Burrows, O.U.P.), vol. I, part 1, p. 11.

[16] Van Riet Lowe, 1947. *S. Afr. Archaeol. Bull.* **2**: 72, site 7.

[17] Breuil & Koslowski, 1931. *Anthropologie* **41**: 449, and (1932) **42**: 27; Breuil, 1939. *Prehistoric Society Proceedings* **5**: 33; Breuil, *Boucher de Perthes* (lecture delivered at Abbeville in 1943 and published 1951).

[18] Zeuner, *The Pleistocene Period*, pp. 153–4.

[19] Breuil & Zbyszewski, 1945. *Contribution à l'étude des industries paléolithiques du Portugal* (Comunicaçoes dos Serviços geológicos de Portugal 26).

[20] Mensching, 1961. *Erdkunde* **15**: 210.

[21] De Lumley, 1963. *Société géologique de France Bulletin* **VII**, 5: 562.

[22] Biberson, *Le cadre paléogéographique de la Préhistoire du Maroc atlantique* (Publ. Service des Antiquités du Maroc 16); id., 1962. *Académie des Sciences Comptes rendus* **254**: 1040.

[23] Davies, *Quaternary in the Coastlands of Guinea*, ch. 3.

[24] Tricart, 1962. *Recherches africaines*, p. 31.

[25] Malik, 1965. *Anthropos* **60**: 198.

[26] Dey, *Quaternaria* **3**: 95.

[27] Laidler, 1934. *S. Afr. J. Sci.* **31**: 535. Cooke, *A preliminary Survey of the Quaternary Period in Southern Africa* (Bureau of Archaeology, Archaeological Series IV).

[28] Ruddock, 1957. *S. Afr. J. Sci.* **53**: 373.

[29] Cp. interstadial claimed at 33 m S.L. at Nice. De Lumley, 1967. *Académie des Sciences Comptes rendus* **264D**: 801.

[30] Van Riet Lowe, 1947. *S. Afr. Archaeol. Bull.* **2**: 69, site 11.

[31] l.c., site 4.

[32] Fleisch and Gigout, 1966. *Société géologique de France Bulletin* **VII** 8: 10.

[33] See also Van Riet Lowe, 1947. *South African Science* **1**: 12.

[34] Van Riet Lowe, l.c., site 3. Davies, 1952. *S. Afr. J. Sci.* **48**: 212.

[35] He could not tell me for certain whether his finds at about 40 m S.L. were made on this terrace or on the higher one.

[36] Kaiser, 1966. *Eiszeitalter und Gegenwart* **17**: 200.

[37] The length of the interglacial suggested by isotopic dates of deep-sea cores and littoral molluscs is in fact about 150000–110000 B.P.; see Rosholt *et al.* 1961. *Journal of Geology* **69**: 162; ibid., 1962. *Journal of Geophysical Research* **67**: 2907; Stearns & Thurber, 1965. *Quaternaria* **7**: 29.

[38] 1935. *S. Afr. J. Sci.* **32**: 488.

[39] See Walsh & Swan, 1952. *S. Afr. J. Sci.* **48**: 284.

[40] *Annals of the University of Stellenbosch* V, A, 1.

[41] Fair, 1943. *Trans. Geol. Soc. S. Afr.* **46**: 13.

[42] Kent, 1938. ibid. **41**: 1.

[43] 1967. *S. Afr. Archaeol. Bull.* **22**: 59.

[44] Van der Hammen *et al.*, 1967. *Geologie en Mijnbouw* **46**: 79.

[45] Brotzen, 1961. *Geologiska Foreningen i Stockholm Förhandlingar* **83**: 144.

[46] John, 1967. *Geological Magazine* **104**: 630. Godwin (1961, *Royal Society Proceedings* **153B**:287) points out that the preceding period was the Irish Sea Advance, the strongest advance of ice in the British Isles during the Würm glaciation; so unusually large accumulation may have been unable to melt during the fairly short interglacial.

[47] 1957. *Geologie en Mijnbouw* **19**: 493.

[48] The sample from Nahoon Point was of dune-rock, so terrestrial sandstone. The date is rather later than most of the others; but as in several parts of the world coastal dunes are thought to accumulate in the early period of a marine regression, when wide coastal sand-flats began to be exposed, this date is a *terminus ante quem* for the maximum of the transgression. Moreover, the date is given by the calcium carbonate cementing the dune-rock. This material comes from fragments of shell, partly marine mixed with the sand and therefore belonging to the maximum of the transgression, and partly terrestrial from the period of formation of the dune. The date from Nahoon Point is therefore an average of a slightly earlier fraction mixed with a slightly later fraction.

[49] Russell, 1963. *Science* **139**: 9.

[50] GaK 652, 655–6, 837, 843, 2129; NSW 3, NZ 349.

[51] *IV Inqua Reports*, p. 547.

[52] 1960. *Journal of Geology* **68**: 626.

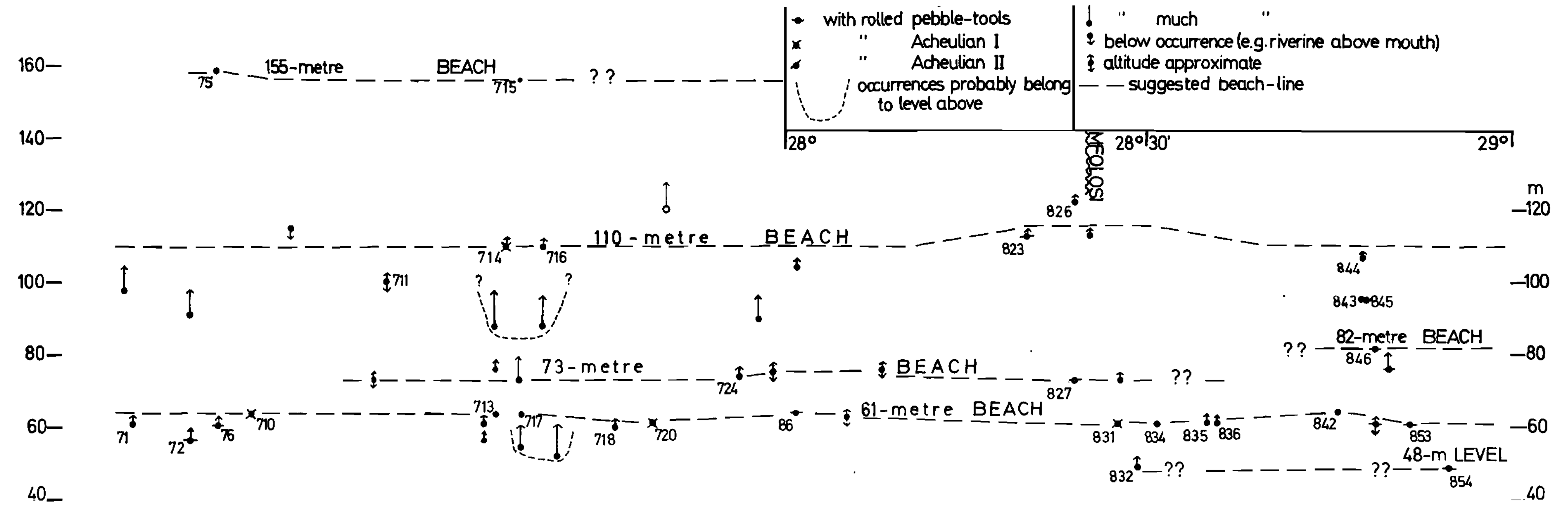
[53] Camps, 1956. *Libyca Anthropologie Archéologie préhistoriques* **3**: 17.

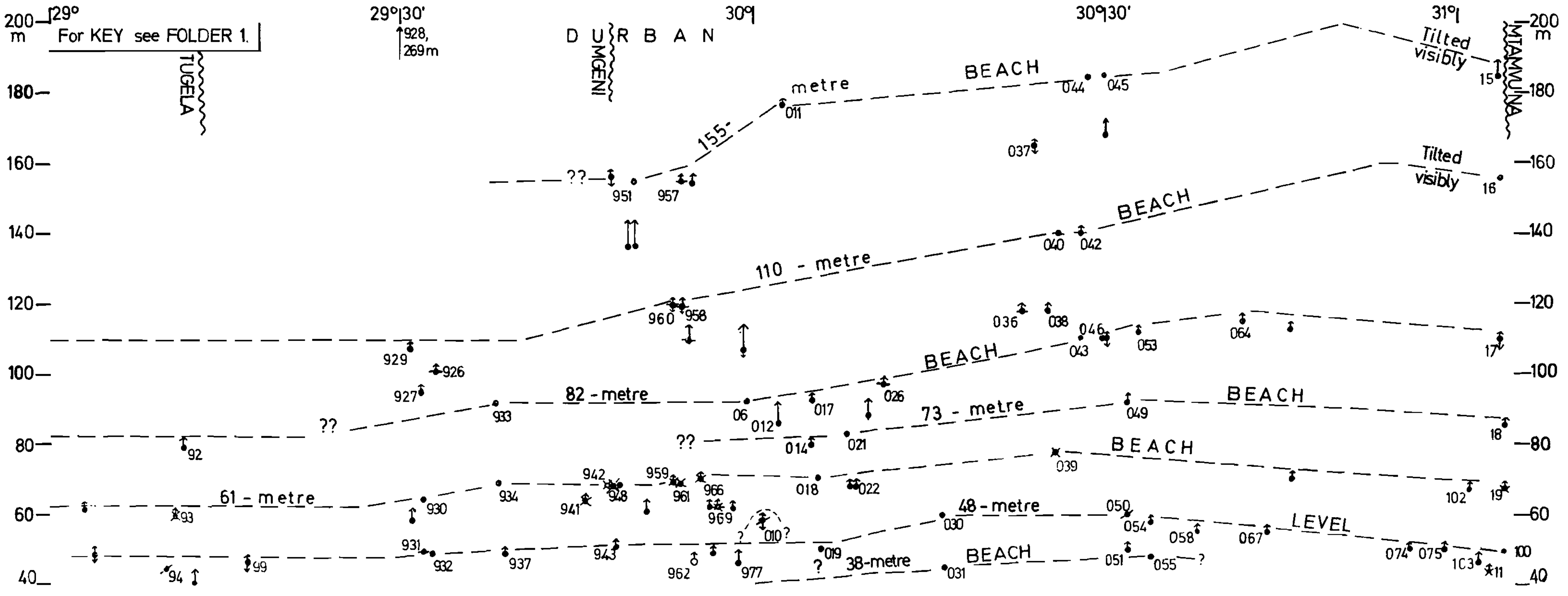
[54] Mountain, 1966. *S. Afr. J. Sci.* **62**: 103; Deacon: 111.

[55] 'Eustatic Changes in Sea Level', especially p. 158, fig. 15; in *Physics and Chemistry of the Earth IV* (Pergamon Press).

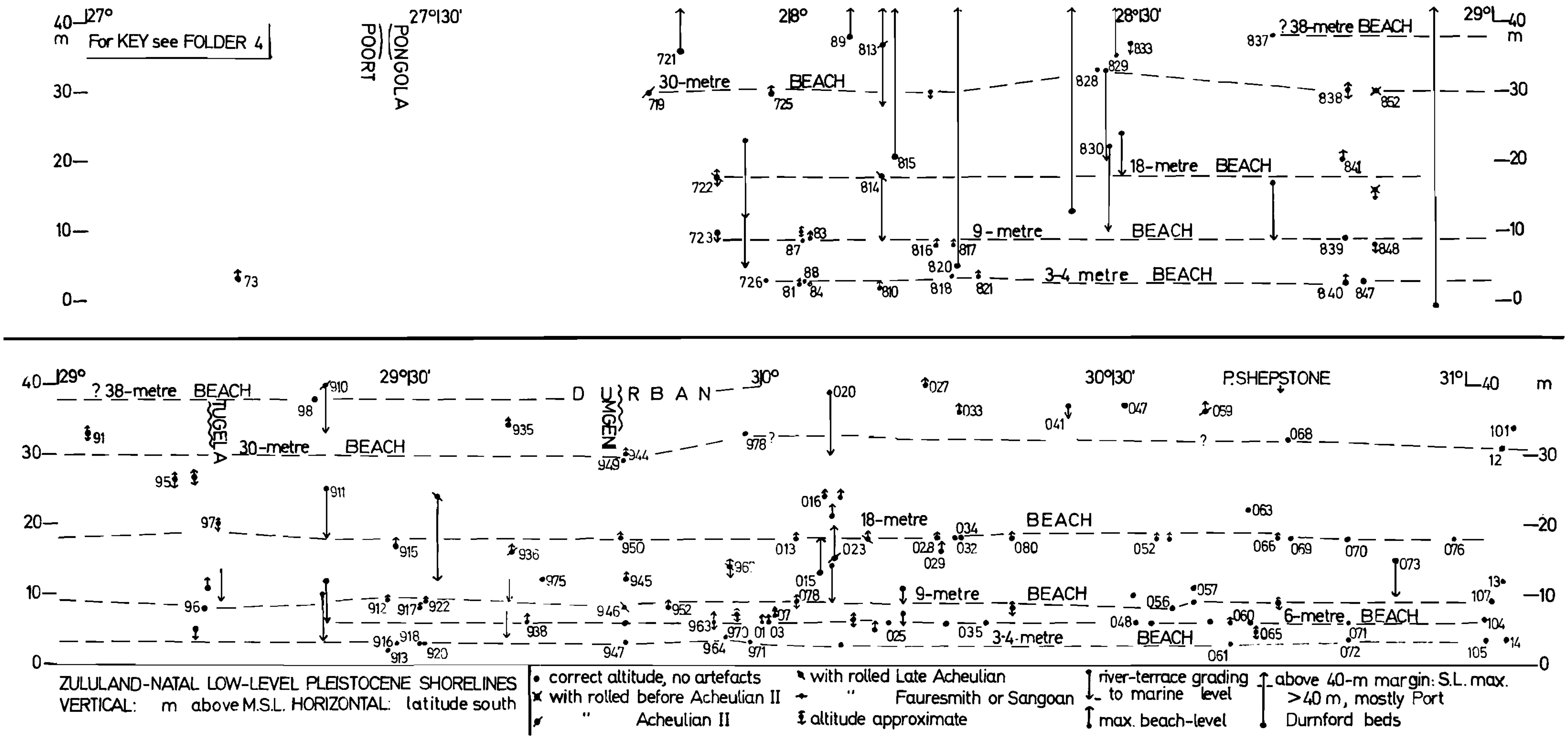
[56] Shepard, *in* Shepard *ed.*, *Recent Sediments North-west Gulf of Mexico*, p. 338; Jelgersma, *Holocene sea-level changes in the Netherlands* (Geologische Stichting Mededelingen C VI 7); Graul, 1959. *Deutsches Geographentag* **32**: 232. This problem was discussed at a colloquium at VIII Inqua (1969), and the papers will be published in *Quaternaria.*

[57] Rock at −47 m at the railway-bridge; see Krige, 1932. *S. Afr. J. Sci.* **29**: 25; id. (1932). *Geological Society of South Africa Transactions* **35**: 37; King & Maud, *Geology of Durban and Environs* (South African Geological Survey Bulletin **42**).


with rolled pebble-tools
" Acheulian I
" Acheulian II
occurrences probably belong to level above
" much "
below occurrence (e.g. riverine above mouth)
altitude approximate
— — suggested beach-line
28°
28°30'
29°
MFOLOSI
m
160—
140—
120—
100—
80—
60—
40
155-metre BEACH ??
110-metre BEACH
73-metre BEACH ??
61-metre BEACH
82-metre BEACH
48-m LEVEL
75 715 714 716 711 713 717 718 720 710 71 72 76 724 86 826 823 827 831 832 834 835 836 842 853 854 844 843 845 846
—120
—100
—80
—60
40


200— m
29°
For KEY see FOLDER 1.
TUGELA
29°30'
928, 269m
D U R B A N
UMGENI
30°
30°30'
31°
MTAMVUNA
—200 m
180—
160—
140—
120—
100—
80—
60—
40
155-metre BEACH
Tilted visibly
110-metre BEACH
82-metre BEACH
73-metre BEACH
61-metre BEACH
48-metre LEVEL
38-metre BEACH
??
011 044 045 15 037 951 957 16 040 042 960 958 036 038 046 043 053 064 17 929 926 927 933 06 012 017 026 049 18 92 014 021 039 942 959 966 018 022 934 930 941 948 961 969 010? 93 050 054 058 067 102 19 030 931 932 937 943 962 977 019 031 051 055 074 075 103 100 11 94 99
—180
—160
—140
—120
—100
—80
—60
—40

FOLDERS 3 and 4



ZULULAND-NATAL LOW-LEVEL PLEISTOCENE SHORELINES
VERTICAL: m above M.S.L. HORIZONTAL: latitude south